CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY RESIDENTIAL AND COMMERCIAL SOLID WASTE COLLECTION VEHICLES

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State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY RESIDENTIAL AND COMMERCIAL SOLID WASTE COLLECTION VEHICLES

Staff Report

June 6, 2003

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LIST OF ACRONYMS

$/lb	Dollars per pound
AB	Assembly bill
ARB, or the Board	Air Resources Board
ATCM	Air toxic control measure
BACT	Best available control technology
CCR	California Code of Regulations
CO	Carbon monoxide
CRRC	California Refuse Removal Council
DECS	Diesel Emission Control System or Strategy
DOC	Diesel Oxidation Catalyst
DRRP, or Diesel Risk Reduction Plan	Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles Risk Reduction Plan
DTSC	Department of Toxic Substances Control
g/bhp-hr	Grams per brake horsepower-hour
GVWR	Gross vehicle weight rating
HC	Hydrocarbon
H&SC	Health and Safety Code
Low sulfur diesel fuel	Diesel fuel with less than 15 ppmw sulfur content
$\mu g/m^3$	Microgram per cubic meter
MY	Model year
Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NOV	Notice of violation
NYGTC	New York garbage truck cycle
OEHHA	Office of Environmental Health Hazard Assessment
O & M	Operation and maintenance
PM	Particulate matter
ppmw	Parts per million by weight
SWCV, or collection vehicle	Solid waste collection vehicle
SCAQMD	South Coast Air Quality Management District
SJVAPCD	San Joaquin Air Pollution Control District
TAC	Toxic air contaminant
tpd	Tons per day
U. S. EPA	United States Environmental Protection Agency
VIN	Vehicle identification number
VOC	Volatile organic carbon

EXECUTIVE SUMMARY

The Air Resources Board, in addition to maintaining long-standing efforts to reduce emissions of ozone precursors, is now challenged to reduce emissions of diesel particulate matter. In 1998, the Air Resources Board identified diesel particulate matter as a toxic air contaminant. Because of the amount of emissions to California's air and its potency, diesel particulate matter is by far the number one contributor to the adverse health impacts of toxic air contaminants.

To address this health concern, the Air Resources Board adopted the "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" in October 2000. The projected emission benefits associated with the full implementation of this plan, including proposed federal measures, are reductions in diesel particulate matter emissions and associated cancer risks of 75 percent by 2010 and 85 percent by 2020. To achieve these goals, the Air Resources Board directed staff to develop specific control measures designed to reduce diesel particulate matter emissions. The objective of each regulation is to reduce diesel particulate matter to the greatest extent possible through technologically feasible measures.

This report describes the proposed "Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Residential and Commercial Solid Waste Collection Vehicle Diesel Engines." The control measure is directed toward the reduction of diesel particulate matter emissions from 1960 to 2006 model years diesel-fueled engines in residential and commercial solid waste collection vehicles. The owners of these collection vehicles must use best available control technology for their engines, which is defined as either an engine alone or in conjunction with a verified diesel emission control strategy that meets a 0.01 gram per brake horsepower-hour particulate matter standard; an alternative-fuel engine or heavy-duty pilot-ignition engine; or application of an Air Resources Board-verified diesel emission control strategy to the engine, which reduces diesel particulate matter emissions by the greatest amount possible for that engine and application. The requirement to install best available control technology will be phased-in between December 31, 2004 and December 31, 2010, by engine model year group.

Municipalities contract, license, and permit many of the solid waste collection vehicle owners covered by this regulation in California. The rates that can be charged by solid waste collection vehicle owners for solid waste collection are regulated in some form by these municipalities. The proposed regulation requires municipalities to bear joint responsibility with vehicle owners for compliance and enforcement of the application of best available control technology to vehicles that operate under contract, license, or permit for solid waste collection. Municipalities also have reporting responsibilities.

In the development of this control measure, staff relied on public involvement and dialogue through public workshops and meetings with groups and individuals.

This measure will reduce diesel particulate matter emissions by 1.03 to 1.15 tons per day (tpd) of particulate matter in 2010. This translates to as high as 81 percent reduction expected in 2010 and up to 85 percent reduction in 2015 of diesel particulate matter from the solid waste collection vehicle fleet. The best available control technologies associated with the proposed regulation are expected to reduce other pollutant emissions, including ozone precursors, as well. Between 3.45 and 3.69 tpd of hydrocarbons, 8.86 and 9.44 tpd of carbon monoxide and 13.0 and 18.08 tpd of oxides of nitrogen may be reduced as a result of this regulation in 2010. Furthermore, cancer risk as a result of exposure to diesel particulate matter will be reduced by a factor of ten from a high of about 31 cancer cases per million to about three in a million in the highest exposure areas.

The costs associated with carrying out this proposed control measure will be on the order of the costs associated with other major Air Resources Board programs to reduce air toxic emissions. The approximate cost effectiveness is $28 per pound of particulate matter reduced, if all of the costs of compliance are allocated to diesel particulate matter reduction. Since this rule will also result in significant reductions in hydrocarbons and oxides of nitrogen emissions, staff allocated half of the costs of compliance against these benefits, resulting in cost-effectiveness values of $13 per pound of diesel particulate matter and $ 0.71 per pound of hydrocarbon plus oxides of nitrogen reduced. Since the proposed regulation impacts solid waste collection vehicles, costs are expected to be passed on to the solid waste collection customers. The cost per household would be about $5.90 per household in total or $0.85 per household annually from 2004 to 2010.

The proposed control measure, as described herein, is consistent with the risk management phase of the “Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles.” The Air Resources Board staff, therefore, recommends that the Board adopt new sections 2020, 2021.1 and 2021.2, title 13, California Code of Regulations (CCR), set forth in the proposed Regulation Order in Appendix A.

I. INTRODUCTION

The Air Resources Board (ARB, or "the Board"), in addition to maintaining long-standing efforts to reduce emissions of ozone precursors, is now challenged to reduce emissions of diesel particulate matter (PM). In 1998, the ARB identified diesel PM as a toxic air contaminant (TAC). Because of the amount of emissions in California's air, and the magnitude of the cancer potency, diesel PM is by far the number one contributor to the adverse health impacts of toxic air contaminants.

The public's exposure to TACs is a significant public health issue in California. In 1983, the California Legislature adopted Assembly Bill (AB) 1807 to enact a program to identify the health effects of TACs and reduce exposure to these contaminants in order to protect public health (Health and Safety Code (H&SC) sections 39650 - 39674). The Legislature established a two-step process to address the potential health effects from TACs. The first step is the risk assessment or identification phase while the second is the risk management or emission reduction phase.

A. Overview and Purpose

After ten years of extensive research and public outreach, the Board identified diesel PM as a TAC in August 1998 (CalEPA 1998). As part of the identification process, the Office of Environmental Health Hazard Assessment (OEHHA) evaluated the potential for diesel exhaust to affect human health. OEHHA found exposure to diesel PM exhaust resulted in an increased risk of cancer and an increase in chronic non-cancer health effects, including a greater incidence of coughing, labored breathing, chest tightness, wheezing, and bronchitis (OEHHA 1998).

Following the identification process, the next step mandated by law is the risk management, or emission reduction phase of the process. ARB staff spent two years working with stakeholders in determining the best control measures for diesel PM. The result was the "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (Diesel Risk Reduction Plan, or DRRP), which was approved by the Board in September 2000. This plan directs staff to develop measures to reduce diesel PM emissions from all diesel-fueled engines and vehicles by developing "new retrofit requirements for existing on-road, off-road, and stationary diesel-fueled engines and vehicles where determined technically feasible and cost-effective."

The proposed diesel PM control measure herein represents the second regulation in a series to implement the Diesel Risk Reduction Plan. It is an important step toward achieving the goal of reducing diesel PM emissions to at or near zero by the year 2020. This rule will be followed by similar regulations to

reduce diesel PM emissions from other sources, such as public fleets, emergency stand-by generators, trucks that transport fuel, transportation refrigeration units, and other on- and off-road vehicles. By 2005, ARB plans to have adopted diesel PM control measures for most mobile and stationary diesel engines, including off-road and portable equipment.

B. Regulatory Authority

The Federal Clean Air Act grants California the authority to control emissions from mobile sources. The California Clean Air Act (H&SC sections 39002, 43013, and 43018) establishes the ARB as the state agency that sets standards for mobile sources. Most important to this regulation, the California Legislature also granted ARB the authority to identify TACs and establish airborne toxic control measures (ATCMs) to reduce risk.

In controlling TACs, the Board is directed to address specific issues pursuant to the need for regulation (H&SC section 39665). These requirements were addressed in detail in the Diesel Risk Reduction Plan, including the extent of present and anticipated future emissions, the estimated levels of human exposure, and the risks associated with those levels. The DRRP (ARB 2000b) describes the physical and chemical characteristics of diesel PM and the contribution to emissions by present sources, as well as the costs, availability, technological feasibility of control measures, and the potential adverse health or environmental impacts. Each of these issues is considered in the development of diesel PM regulations and will be discussed in this report specifically as each relates to this control measure.

C. Current Regulations and Voluntary Programs

Both the Federal government and the State of California have adopted rules that reduce diesel PM from on-and off-road vehicles. The following sections briefly describe the existing federal, state, local and voluntary programs that currently apply to diesel-fueled engines and vehicles operating in California.

1. Federal Regulations

Standards for smoke emissions from on-road heavy-duty diesel vehicles were set by the United States Environmental Protection Agency (U.S. EPA) in 1970. New engines were subject to PM exhaust emission standards with model year (MY) 1988. Over the years, more stringent emission standards have paralleled improvements in control technology. Recent amendments to the on-road standards regulate the heavy-duty vehicle and its fuel as a single system, including diesel-fuel sulfur-content requirements. The particulate standard for new heavy-duty diesel engines is 0.01 grams per brake-horsepower hour (g/bhp-hr), which is a 90 percent reduction from the existing standard, and will take effect with MY 2007. That standard is based on the use of high-efficiency

exhaust emission control devices or comparably effective advanced technologies. Because these devices are less efficient when used with the current formulation of diesel fuel, reducing the level of sulfur in highway diesel fuel by 97 percent to 15 parts per million by weight (ppmw) by mid-2006 is also required.

Whereas the current PM engine emission standard for on-road heavy-duty diesel trucks is 0.1 g/bhp-hr, the current federal PM emission standard for new urban transit bus engines is 0.05 g/bhp-hr. On April 23, 1993, the U.S. EPA finalized the Urban Bus Retrofit/Rebuild Program to reduce the ambient levels of diesel PM in urban areas. The program is limited to 1993 and earlier model year urban buses operating in metropolitan areas with 1980 populations of 750,000 or more, whose engines are rebuilt or replaced after January 1, 1995. Approximately 40 urban areas are affected. Operators of the affected buses are required to choose between two compliance options: Program 1 sets PM emissions requirements for each urban bus engine in an operator's fleet which is rebuilt or replaced; Program 2 is a fleet averaging program that establishes specific annual target levels for average PM emissions from urban buses in an operator's fleet.

Other than the Urban Bus Retrofit/Rebuild Program, no other federal regulations exist mandating reducing emissions from in-use heavy-duty engines.

2. California Regulations

California is the only state granted the authority in the Federal Clean Air Act to set standards for mobile engines. While its passenger car standards are more stringent than federal standards, in the area of new heavy-duty diesel engines California has generally harmonized with federal rules. However, California has also adopted regulations to ensure compliance with smoke standards. California's Heavy Duty Vehicle Inspection and Periodic Smoke Inspection Programs reduce excessive smoke emissions and tampering with diesel-fueled vehicles over 6,000 pounds gross vehicle weight rating (GVWR) and apply to all trucks traveling within California. The regulations impose limits on the opacity of smoke from diesel engines when measured in accordance with a snap-acceleration test procedure, and have been in effect since 1991, with amendments adopted in 1997.

Another source for which California has adopted more stringent regulations than the U.S. EPA is urban transit buses. The Fleet Rule for Transit Agencies, adopted in February 2000 and amended in October 2002, is designed to achieve significant reductions in diesel PM and oxides of nitrogen (NOx) emissions from 2001 to 2015 through the implementation of a fleet rule and increasingly stringent engine standards. Emission reductions are achieved as transit agencies purchase new lower-emission buses or repower older, higher-emitting buses to lower-emitting configurations. Reductions in diesel PM are also mandated beginning January 1, 2004, and the use of diesel fuel with less than 15 ppmw

sulfur content (low sulfur diesel fuel) is required, beginning July 1, 2002. For new engines, long-term emission reductions are achieved through establishing increasingly more stringent new engine standards. The particulate standard for new engines sold in California is 0.01 g/bhp-hr for engines produced as of October 1, 2002. Over time, ultra-low, near-zero, and zero emissions buses will replace older higher emitting engines.

3. Local Regulations

The South Coast Air Quality Management District Rule 1193, "Clean On-Road Residential and Commercial Refuse Collection Vehicles," was adopted June 16, 2000 (SCAQMD 2000). This rule dictates that solid waste collection fleets operating in the SCAQMD may only purchase alternative-fuel vehicles, and applies to government agencies and private companies with fleets of 15 or more. Compliance deadlines are July 1, 2001, for fleet operators of 50 or more collection vehicles; and July 1, 2002, for fleet operators of 15 or more collection vehicles. Prior to July 1, 2003, operators may purchase dual-fuel vehicles in lieu of dedicated alternative-fuel vehicles. Amendments proposed in April 2003 would extend the date allowing purchase of dual-fuel vehicles to July 1, 2004.

4. Voluntary and Incentive Programs

Voluntary efforts play a key role in helping to achieve air quality goals. Incentives or early implementation credits can induce vehicle owners to reduce vehicle emissions prior to compliance deadlines or in excess of regulatory requirements.

The California Legislature established the Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) in 1998 to reduce NOx emissions from existing vehicles. The Moyer Program funds the incremental cost of repower, retrofit, or purchase of new, cleaner engines that meet a specified cost-effectiveness level for NOx reduction. In addition, the Moyer Program has a statewide 25 percent PM emission reduction target and a 25 percent PM emission reduction requirement for districts in serious nonattainment for federal PM_{10} standards. Total Moyer Program funding since fiscal year 1998/1999 has been approximately $114 million.

In 2000, the Legislature approved new funds to reduce emissions from school buses. The ARB, in coordination with the California Energy Commission and the local air pollution control districts, established guidelines for the Lower-Emissions School Bus program. The goal of this incentive program is to reduce the exposure of school children to both cancer-causing and smog-forming compounds. This program utilizes two strategies to attain these goals: pre-1987 model year school bus replacement and in-use controls for later model year diesel-fueled school buses. Over fiscal years 2000/2001 and 2001/2002, program funding was $66 million total.

Voters approved Proposition 40, the California Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act of 2000, which granted additional funding to reduce diesel emissions. The measure provides about $50 million over two years to ARB, 20 percent of which is to be spent for the acquisition of "clean, safe, school buses for use in California's public schools." The remainder is allocated to the Moyer Program.

On the federal level, the U.S. EPA established a Voluntary Diesel Retrofit Program in 2000 to address pollution from diesel construction equipment and heavy-duty on-highway vehicles. This program allows fleet operators to choose appropriate, U.S. EPA-verified technologies that will reduce the emissions of the vehicles and engines in their fleets and identify potential funding sources to assist air quality planners and fleet operators as they create and implement retrofit programs. The program assists air quality planners in determining the number of State Implementation Plan credits produced by their retrofit projects. The U.S. EPA has also established a program to fund school bus retrofits and replacements from penalty revenues.

II. PUBLIC OUTREACH

The ARB is committed to ensuring that all California communities have clean, healthful air by addressing not only the regional smog that hangs over our cities but also the nearby toxic pollution that is generated within our communities. The ARB works to ensure that all individuals in California, especially the children and elderly, can live, work and play in a healthful environment that is free from harmful exposure to air pollution.

A. Environmental Justice

The ARB is committed to integrating environmental justice in all its activities. On December 13, 2001 (ARB 2001d), the Board approved Environmental Justice Policies and Actions,[1] which formally established a framework for incorporating environmental justice into the ARB's programs, consistent with the directives of State law. Environmental justice is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

To achieve this ambitious goal, the ARB has established a Community Health Program and placed new emphasis on community health issues in our existing programs. The Neighborhood Assessment Program is a key component in the Community Health Program. The Neighborhood Assessment Program Work

[1] Complete information for these programs can be found at http://www.arb.ca.gov/ch/ej.htm.

Plan presents a plan that the ARB staff proposes to use to develop guidelines for evaluating and reducing air pollution impacts at the neighborhood-scale (ARB 2000a).

The Environmental Justice Policies are intended to promote the fair treatment of all Californians and cover the full spectrum of ARB activities. Underlying these Policies is a recognition that we need to engage community members in a meaningful way as we carry out our activities. People should have the best possible information about the air they breathe and what is being done to reduce unhealthful air pollution in their communities. The ARB recognizes its obligation to work closely with all stakeholders; communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement these Policies.

This control measure is in direct response to the environmental justice policy to reduce health risks from toxic air pollutants in all communities, especially low-income and minority communities. This control measure, when adopted, will provide immediate air-quality benefits by reducing diesel PM emissions from collection vehicles, which operate in neighborhoods. The actions we have taken in applying these policies in our rulemaking reflect the Board's commitment to the fair treatment of all people throughout California.

In addressing the environmental justice policy to support research and data collection needed to reduce cumulative emissions and health risks in all communities, ARB has initiated various studies to better understand issues such as the physical and chemical characteristics of diesel PM and demonstrations of emission control technologies. Staff has conducted a focused risk assessment to characterize near-source dispersion patterns of diesel PM as they relate to collection vehicles. The results of this study are discussed in Section III.F.

B. Outreach Efforts

As part of the environmental justice policy to strengthen our outreach and education efforts in all communities, staff conducted extensive workshops and meetings in the development of this rule from December 2000 through May 2003. The meetings were held at times and locations that encouraged public participation, including late afternoon and evening sessions. Attendees included representatives from environmental organizations, waste management companies and service providers, associations, and other parties interested in residential waste removal (Appendix B). These individuals participated both by providing data and reviewing draft regulations and by participating in open forum workshops, in which staff directly addressed their concerns.

Staff met with a number of stakeholders' groups throughout the rulemaking process. Representatives of the California Refuse Removal Council (CRRC) assisted us in gathering data from their members and also provided input in

developing our data survey forms. These initial meetings led to the formation of an industry workgroup. This workgroup met six times over the course of a year, during which staff worked closely with a group of collection vehicle fleet owners, their CRRC representatives, and representatives of non-CRRC member companies to review preliminary draft regulations thoroughly and work together to resolve outstanding issues. Alternatives were suggested to the proposed regulation and explored by staff.

The staff held two meetings with municipalities that contract for solid waste collection or provide direct waste removal service, in addition to individual contacts. These meetings were influential in helping determine specific feasibility and implementation of the financial and enforcement sections of the proposed regulation. Staff also met with the Californians for a Sound Fuel Strategy, a coalition led by the California Chamber of Commerce, to discuss specific issues.

Staff also conducted outreach through telephone calls and site visits with approximately 65 collection vehicle owners during the data collection phase of feasibility studies to determine the engine exhaust temperatures and fleet maintenance. A wide demographic of fleet types was covered by this outreach, including both public and private fleets, and small and large fleets.

In 2001 and 2002, ARB held ten workshops in preparing this rule, with both afternoon and evening sessions, in four different locations to accommodate as many people as possible (**Table 1**). Over 2,500 individuals and/or companies were notified through a series of mailings and a large number of people participated (Appendix B). In addition, notices were posted to the diesel risk reduction and collection vehicle rule web sites and e-mailed to subscribers of ARB's electronic list server.

Table 1. Workshop Locations and Times.

Date	Location	Time
June 26, 2001	Sacramento	2:30 – 4:30 PM
June 26, 2001	Sacramento	6:30 – 8:30 PM
June 28, 2001	El Monte	2:30 – 4:30 PM
June 28, 2001	El Monte	6:30 – 8:30 PM
September 4, 2001	Sacramento	1:30 – 3:30 PM
September 5, 2001	Los Angeles	1:30 – 3:30 PM
February 26, 2002	Oakland	2:00 – 4:00 PM
February 28, 2002	El Monte	4:00 – 6:00 PM
December 9, 2002	Sacramento	2:00 – 5:00 PM
December 10, 2002	El Monte	2:00 – 5:00 PM

To generate additional public participation and to enhance the information flow between ARB and interested persons, staff made all documents, including workshop presentations, available via the ARB's Internet web sites on diesel risk reduction and the collection vehicle rule.[2] The web sites provide background information on diesel PM, including fact sheets, workshop dates and locations, and other diesel related information and serves as a portal to other web sites with related information.

Staff will continue outreach and education efforts following the adoption of the regulation to both municipalities and collection vehicle owners. Outreach plans include development of a guidance document to describe compliance mechanisms and technologies; training classes targeting mechanics and maintenance personnel; and an enhanced web site. Staff will also develop optional reporting forms for use by municipalities.

III. NEED FOR REDUCTION OF DIESEL PARTICULATE MATTER EMISSIONS

Diesel PM is a complex mixture that consists of dry solid fragments, solid cores with liquid coatings and small droplets of liquid. These tiny particles vary greatly in shape, size and chemical composition and can be divided into several size fractions. Coarse particles are between 2.5 and ten microns in diameter, and arise primarily from natural processes, such as wind-blown dust or soil. Fine particles are less than 2.5 microns in diameter and are produced mostly from combustion, or burning activities and are termed $PM_{2.5}$. Particles with an aerodynamic diameter less than or equal to a nominal ten microns (about 1/7 the diameter of a single human hair) are termed PM_{10}; PM_{10} is a criteria air pollutant for which federal and state ambient air quality standards have been set. Diesel PM is a subset of PM_{10}.

A. Ambient Air Quality Standards for Particulate Matter

Both the California and the U.S. EPA have established standards for the amount of PM_{10} in the ambient air. These standards define the maximum amount of particles that can be present in outdoor air without threatening the public's health and welfare. California's current PM_{10} standard is more protective of human health than the corresponding national standard. Standards for $PM_{2.5}$ have also been established to further protect public health (**Table 2**).

[2] Located at http://www.arb.ca.gov/diesel/dieselrrp.htm and http://www.arb.ca.gov/msprog/SWCV/SWCV.htm.

Table 2. State and National Particulate Matter Standards.

California Standard		National Standard	
PM_{10}			
Annual Arithmetic Mean	20 $\mu g/m^3$	Annual Arithmetic Mean	50 $\mu g/m^3$
24 Hour Average	50 $\mu g/m^3$	24 Hour Average	150 $\mu g/m^3$
$PM_{2.5}$			
Annual Arithmetic Mean	12 $\mu g/m^3$	Annual Arithmetic Mean	15 $\mu g/m^3$
24 Hour Average	No separate State standard	24 Hour Average	65 $\mu g/m^3$

When the ARB sets California's ambient air quality standards, it designs them to protect the most sensitive subpopulations, whether that is children, the elderly, or people with pre-existing disease, such as cardiac patients or asthmatics.

B. Identification of Diesel Particulate Matter as a Toxic Air Contaminant

After ten years of extensive research and public outreach, ARB identified diesel PM as a TAC in August 1998 (CalEPA 1998). As part of the identification process, OEHHA evaluated the potential for diesel exhaust to affect human health. OEHHA found that exposures to diesel PM resulted in an increased risk of cancer and an increase in chronic non-cancer health effects, including a greater incidence of cough, labored breathing, chest tightness, wheezing, and bronchitis (OEHHA 1998). OEHHA estimated, based on available studies, that the potential cancer risk for exposure to diesel PM in concentrations of one microgram per cubic meter ($\mu g/m^3$) ranged from 130 to 2400 excess cancers per million. The ARB's Scientific Review Panel approved OEHHA's determinations concerning health effects and approved the range of risk for PM from diesel-fueled engines, concluding that a value of 300 excess cancers per million people, per $\mu g/m^3$ of diesel PM, was appropriate as a point estimate of unit risk for diesel PM.

OEHHA also concluded that exposure to diesel PM in concentrations exceeding five $\mu g/m^3$ can result in a number of long-term chronic health effects. The five $\mu g/m^3$ value is referred to as the chronic reference exposure value for diesel PM. The SRP supported OEHHA's conclusion and noted that the reference exposure value may need to be lowered further as more data emerge on potential adverse chronic effects of diesel PM.

C. Physical and Chemical Characteristics of Diesel Particulate Matter

Diesel PM is the non-gaseous portion of the exhaust from a diesel-fueled compression ignition engine. PM emissions result from incomplete combustion of fuel in the cylinder and lubrication oil that has entered the cylinder incidentally.

Diesel PM consists of several constituents, including an elemental carbon fraction, a soluble organic fraction, and a sulfate fraction. The majority of diesel PM, approximately 98 percent, is smaller than ten microns in diameter. Diesel PM is a mixture of materials containing over 450 different components, including vapors and fine particles coated with organic substances. Over 40 chemicals in diesel exhaust are considered TACs by the State of California (**Table 3**).

Table 3. Substances in Diesel Exhaust Listed by California as Toxic Air Contaminants.

Acetaldehyde	Manganese compounds
Acrolein	Mercury compounds
Aniline	Methanol
Antimony compounds	Methyl Ethyl Ketone
Arsenic	Naphthalene
Benzene	Nickel
Beryllium compounds	4-Nitrobiphenyl
Biphenyl	Phenol
Bis[2-ethylhexyl]phthalate	Phosphorus
1,3-Butadiene	Polycyclic organic matter,
Cadmium	including polycyclic aromatic
Chlorine	hydrocarbons (PAHs) and their
Chlorobenzene	derivatives
Chromium compounds	
Cobalt compounds	Propionaldehyde
Creosol isomers	Selenium compounds
Cyanide compounds	Styrene
Dibutylphthalate	Toluene
Dioxins and dibenzofurans	Xylene isomers and mixtures
Ethyl benzene	o-Xylenes
Formaldehyde	m-Xylenes
Inorganic lead	p-Xylenes

Note: California H&SC section 39655 defines a TAC as "an air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health."

D. Sources and Ambient Concentrations Of Diesel Particulate Matter

PM emissions from diesel-fueled vehicles and engines totaled about 28,000 tons per year in California as of 2000 (ARB 2000b). These emissions come from a wide variety of sources including over one million on-road and off-road vehicles, about 16,000 stationary engines, and close to 50,000 portable engines. On-road engines account for about 27 percent of the emissions, off-road engines and portable engines about 71 percent, and the remaining two percent from stationary engines. With full implementation of the current vehicle standards and vehicle turnover, but not considering this control measure, diesel PM emissions

will still total about 22,000 tons per year in 2010 and about 19,000 tons per year in 2020.

In the year 2000, outdoor diesel PM concentrations were 1.8 $\mu g/m^3$ and projected to be 1.5 $\mu g/m^3$ in 2010 after accounting for current regulations. After including indoor concentrations of diesel PM, total exposure was 1.26 $\mu g/m^3$ in 2000 and projected to be 1.05 $\mu g/m^3$ in 2010 (**Table 4**).

Table 4. Estimated Exposure of Californians to Diesel Particulate Matter for 2000, 2010 and 2020 (ARB 2000b).

Exposure Location	Estimated Average Air Exposure Concentration – 1990 ($\mu g/m^3$)	Estimated Average Air Exposure Concentration ($\mu g/m^3$) and Potential Risk (excess cancers/million)					
		2000		2010		2020	
		Conc.	Risk	Conc.	Risk	Conc.	Risk
Outdoor Ambient	3.0	1.8	540	1.5	450	1.2	360
Indoor	2.0	1.2	360	1.0	300	0.8	240
Total	2.1	1.26	380	1.05	315	0.84	252

E. Health Effects of Diesel Particulate Matter

Diesel PM has been linked to a wide range of serious health problems. Particles that are deposited deep in the lungs can result in lung cancer, increased hospital admissions; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; alterations in lung tissue and respiratory tract defense mechanisms; and premature death. Increased PM exposure causes increased cardiopulmonary mortality risk as demonstrated in a validity and causality analysis of 57 epidemiological studies. (Dab et al. 2001). Significant positive associations exist between lung cancer incidence and the number of days per year that respirable particulates (PM_{10}) exceeded several thresholds (Beeson et al. 1998).

Long-term ambient concentrations of PM_{10} are associated with increased risks of all natural cause mortality in males, mortality with any mention of nonmalignant respiratory causes in both sexes, and lung cancer mortality in males (Abbey 2000; McDonnell *et al.* 2000). Initial findings indicate a clear correlation between lower lung function and more intense air pollution and high levels of nitrogen dioxide (NO_2), PM_{10}, $PM_{2.5}$, and acid vapor appear to be associated with slower lung growth (Peters 1991).

F. Risk Assessment

This section presents a brief summary of the potential cancer health risk associated with exposures to diesel PM emissions from all diesel-fueled engines in California. We also examine the potential cancer health risks associated with

exposure to solid waste collection activities and the reduction in risk that will occur upon implementation of the proposed control measure.

1. Statewide Risk Reduction Goal of Diesel Risk Reduction Plan

Diesel PM is emitted from a variety of sources, including on- and off-road diesel-fueled vehicles and stationary engines. On a statewide basis, the average potential cancer risk associated with diesel PM emissions is 540 potential cases per million statewide, with the potential risk in the South Coast Air Basin estimated to be 1,000 per million people. Compared to other air toxics the Board has identified and controlled, diesel PM emissions are estimated to be responsible for about 70 percent of the total ambient air toxics risk. In addition to these general risks, diesel PM can also present elevated localized or near-source exposures. Depending on the activity and nearness to receptors, these potential risks can range from small to 1,500 per million or more.

The goal of the Diesel Risk Reduction Plan is to reduce diesel PM emissions and the associated cancer risk by 75 percent in 2010 and 85 percent in 2020 (**Figure 1**). This regulation is one of a group of regulations being developed to achieve the emission reduction goals of the Diesel Risk Reduction Plan of protecting the health of Californians by reducing the cancer risk from diesel PM and complying with legal requirements to control a TAC. Other benefits associated with reducing diesel PM emissions include increased visibility, less material damage from soiling of surfaces, and reduced incidence of non-cancer health effects, such as bronchitis, asthma, and allergy.

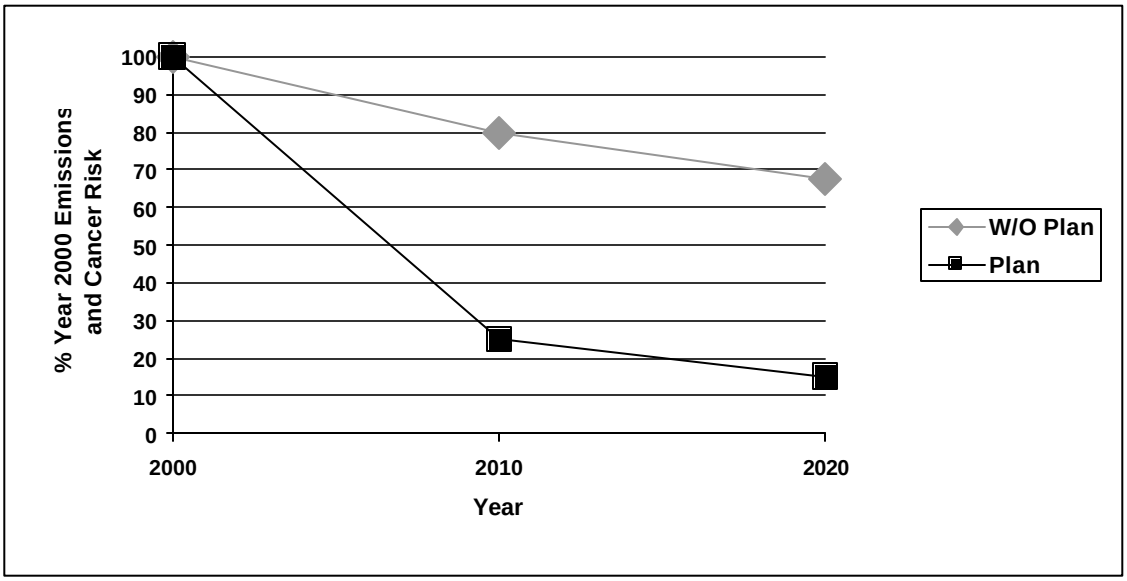

Figure 1. Statewide Reduction in Diesel PM Emissions and Risk to Californians With and Without the Diesel Risk Reduction Plan.

2. Collection Vehicle Health Risk Assessment

To examine the potential cancer health risks associated with exposure to PM emissions from collection vehicle activities, ARB staff identified several operating scenarios representing typical collection vehicle activities and determined the potential risk associated with these hypothetical scenarios. The detailed methodology used to estimate the potential cancer health risks is presented in Appendix D of this report. Noncancer chronic and acute health effects were not considered in this evaluation, although they are important. Cancer health impacts from inhalation exposure to diesel PM outweigh the noncancer multipathway health impacts to the speciated components of diesel PM.

Risk assessment is a complex process that requires the analysis of many variables to simulate real-world situations. Three key types of variables can impact the results of a health risk assessment for collection vehicle activities – the magnitude of the diesel PM emissions, the meteorological conditions, and the length of time someone is exposed to the emissions. The quantity of diesel PM emissions is a function of the age of the collection vehicle, how many collection vehicles are in a given area, and the operating schedules of these vehicles. Older vehicles tend to have greater emissions than newer vehicles and the more frequently a vehicle accesses a neighborhood, the greater the emissions in a neighborhood. Meteorological conditions can have a large impact on the resultant ambient concentration of diesel PM with higher concentrations found along the predominant wind direction and under calm wind conditions. A person's proximity to the emission plume and how long he or she breathes the emissions (exposure duration) are key factors in determining potential risk. The longer the exposure time, the greater the potential risk.

In order to examine the range of potential cancer health risks associated with exposure to diesel PM emissions from collection vehicle activities and the reduction in risk due to the implementation of this control measure, ARB staff evaluated three hypothetical exposure scenarios. In the first scenario, staff examined the potential cancer risk in a residential neighborhood due to solid waste collection. In the second scenario, staff determined the potential cancer risk in a mixed commercial/residential neighborhood with more frequent solid waste collection than in the first scenario. In the third scenario, staff calculated the potential cancer risk to residents living along a roadway leading to a solid waste disposal site.

The analyses were performed using the U.S. EPA's CAL3QHCR dispersion model to estimate the annual average diesel PM concentrations. Fleet weighted emission factors were developed based on EMFAC2000 emission factors and the New York Garbage Truck Cycle (NYGTC) testing conducted by West Virginia University. Meteorological data from Anaheim was selected to provide meteorological conditions representative of an urban area. The estimated annual average diesel PM concentrations were then adjusted to take into consideration

how long a person might breathe these emissions. Consistent with the current risk assessment methodology recommended by the OEHHA and used by ARB in evaluating potential cancer risk from diesel PM emission sources, ARB staff assumed nearby residents would be exposed to the modeled diesel PM concentrations for 70 years. This exposure duration represented an "upper-bound" of the possible exposure duration. The potential cancer risk was estimated by multiplying the modeled annual average concentration of diesel PM by the unit risk factor for diesel PM (300 excess cancers per million people per $\mu g/m^3$ of diesel PM).

Based on this evaluation, we found the estimated risk from collection vehicles operating in a residential or mixed used area varies depending on the age and number of collection vehicles operating in the neighborhood on a weekly basis. As expected, the maximum risk and the highest average risk would occur in neighborhoods serviced by older trucks and multiple trucks servicing the area (i.e., separate collection for trash and recyclables). In most cases, however, the potential cancer health risk in a neighborhood was less than ten potential cancer cases in a million. The potential cancer risk was greater along the road leading to a landfill due to the high frequency of vehicle trips. For this scenario the potential cancer health risk varied with the volume of vehicle traffic and the distance from the road. At 50 meters, the risk ranged from six to 18 potential cancer cases in a million.

Reducing diesel PM emission from the collection vehicles will result in a reduction of the potential cancer health risks. Based on the risk scenarios, staff concluded the reductions in diesel PM emissions that will result from implementation of the collection vehicle control measure will result in a reduction in the associated potential cancer risk. Our analyses show an 85 percent reduction in diesel PM emissions will reduce the potential health risk levels in most cases to less than one potential cancer case in a million.

These estimated risk levels provide a quantitative assessment of the potential risk levels in hypothetical neighborhoods. As mentioned previously, actual risk levels from collection vehicles at any individual site will vary with site specific parameters, including engine technologies, diesel emission control strategies (DECS), emission rates, fuel properties, operating schedules, meteorology, and the actual location of off-site receptors. In addition, although the overall magnitude of the diesel PM emissions and risk reductions from the collection vehicle control measure may appear modest, reducing these emissions are necessary if we are to achieve the ultimate goals outlined in the Diesel Risk Reduction Plan and to fulfill the requirements of H&SC section 39666. As described in the DRRP (ARB 2000b), it is necessary to reduce diesel PM emissions from essentially all diesel-fueled engines if we are to be successful in reducing the significant public health risk associated with diesel PM. Also, because diesel PM is a non-threshold carcinogen, California is required, under

H&SC section 39666, to reduce emissions to the lowest level achievable through the application of best available control technology (BACT).

IV. ENGINE AND EMISSION INVENTORY

An improved engine and emission inventory was developed for this rule proposal, including a new survey of collection vehicles in California (Appendix E of this document and Technical Support Document, Appendix C). California's emission inventory includes data on a vehicle level. Engine data are critical, however, to the understanding of how many vehicles will be able to apply what types of BACT. Thus, staff undertook a detailed survey to determine the engine make, model, model year, and vehicle type of the collection vehicles in California.

A. Engine Inventory

ARB has estimated the 2000 population of collection vehicles covered by this proposal to be approximately 11,800. The 2010 population is projected to be about 13,100 collection vehicles. ARB staff gathered engine and fleet data for approximately 70 percent of the California collection vehicles. Staff extrapolated these data to obtain a picture of the entire fleet of California collection vehicles (**Table 5**). Details regarding the methodology and results are presented in Appendix C of the Technical Support Document and the analysis and implications of the data for the use of BACT are discussed in the Technical Support Document.

Table 5. California's Collection Vehicles by Type and Model Year Group.

Engine Model Year Group	Collection Vehicle Type				Total By Engine MY Group
	Front Loaders	Rear Loaders	Roll Offs	Side Loaders	
1960-1987	5%	8%	3%	2%	18%
1988-1990	6%	9%	2%	4%	21%
1991-1993	5%	4%	1%	7%	17%
1994-2002	10%	6%	3%	25%	44%
Total by Vehicle Type	26%	27%	9%	38%	100%

B. Emission Inventory

Substantial improvements have been made to the emissions inventory for California on-road in-use collection vehicles. Updated population and turn over (useful life) data, and emission rates have been incorporated into the revised inventory (Appendix E). In 2000, the population of collection vehicles was 11,778, according to an ARB analysis of Department of Motor Vehicles data. The population is expected to increase slowly during the implementation of this regulation due to population increase in the State and a corresponding slow increase in solid waste collection needs to over 13,100 collection vehicles. Fleet

turnover (the time a vehicle is retired from service) is expected to remain relatively slow.

Three possible implementation scenarios were used for the emissions benefits calculations (**Table 6**). The first is based on the implementation of currently verified in-use DECSs (Current). The second and third scenarios are based on no Level 2 DECSs verified (Potential 1) and Level 2 DECSs verified for all model years (Potential 2). The scenarios, which are detailed in Tables 15 – 17, are discussed in greater depth in the Technical Support Document. In short, the Current scenario, based on current DECS verifications, assumes that 30 percent of SWCVs will use Level 1 technology, 12 percent will use Level 3 technology, and 58 percent will either be repowered or replaced with engines meeting the 0.01 gpbhp-hr PM standard. Scenario Potential 1 assumes a greater percentage of vehicles will use Level 1 technology, 47 percent; the same number will use Level 3 technology, 12 percent; and 41 percent will repower or replace. Finally, Potential 2 scenario assumes a high number of vehicles will use Level 2 technology, 43 percent; and only 4 percent will use Level 1 technology. As with Potential 1, 12 percent are assumed to use Level 3 technology and 41 percent are assumed to be repowered or replaced. The option of converting to alternative-fuel or heavy-duty pilot ignition engines exists for all engines either through vehicle replacement or conversion of the engine. This option is included in the scenarios as repower or replace.

Table 6. Three Possible Scenarios for Diesel Particulate Matter Emission Reductions Based on Diesel Emission Control Strategy Verification.

Calendar Year	Baseline Inventory[a] (tpd)	PM Emissions Reduction		
		Current	Potential 1	Potential 2
2005	1.57	3%	6%	10%
2010	1.42	81%	72%	79%
2015	1.36	85%	71%	78%
2020	1.12	82%	67%	75%

[a] PM emissions without the proposed rulemaking.

Under these three scenarios, the diesel PM emissions from collection vehicles are expected to be reduced from a baseline inventory of 1.57 tons per day (tpd) in 2005 by between 72 and 81 percent in 2010 and between 67 and 82 percent in 2020 (**Table 6**). The greatest diesel PM emission reductions would be achieved under the Current scenario, because the Current scenario is weighted toward engine repowers. Fewer repowers are predicted in the Potential 1 and Potential 2 scenarios, which assume greater use of DECS that reduce diesel PM by less than 85 percent (Level 3). The Potential 2 scenario predicts greater PM reductions than Potential 1 because Potential 2 assumes that almost half of the

SWCVs will use Level 2 technologies, which reduce diesel PM more than Level 1 technologies.

Emissions of HC, CO, and NO_x are also predicted to be reduced as a result of this regulation as discussed in Section IX.

V. SUMMARY OF PROPOSED CONTROL MEASURE

A. Scope and Applicability

The core of this proposal is a requirement that owners of collection vehicles apply BACT to their vehicles to reduce diesel PM emissions. The proposed regulation imposes duties on collection vehicle owners (owners) and cities, counties, and governmental agencies that contract for solid waste collection services (municipalities). The proposed rule applies to a collection vehicle that has a manufacturer's GVWR greater than 14,000 pounds and a MY 1960 to 2006 engine. A collection vehicle that operates in residential and commercial-mixed use neighborhoods directly impacts public exposure in the home and office. Municipalities have the ultimate responsibility for solid waste collection, thus they are jointly responsible with collection vehicle owners for implementing this regulation.

B. Determining Compliance of a Municipality with this Control Measure

A little over half of California's collection vehicles are under contract to a municipality to provide residential and commercial solid waste collection service (**Figure 2**). The municipalities, therefore, are critical stakeholders in the success of this proposed regulation. Staff proposes that municipalities require compliance with this regulation as a stipulation of any contract, license, or permit the collection vehicle owner has with the municipality and that a collection vehicle owner must comply with this regulation in order to maintain any contracts, permits, or licenses to operate for a municipality. Municipalities have told staff that contracts already require compliance with applicable regulations, thus this requirement is not burdensome. Some municipalities, however, may need to amend existing contracts so that the cost of complying with these regulations can be incorporated into the rate base of a contract.

Staff additionally proposes that municipalities be required to track compliance with the regulation through collecting signed statements from their contractors annually, which should ensure that municipalities and collection vehicle owners work together to comply with the regulation. The municipality is also required to submit a description of the total cost and funding source that will be used to bring a contractor into compliance with its initial report to ARB by August 1, 2004. The initial report will be used to ensure that rate-regulated contractors and the municipalities are discussing funding for compliance. Following the initial report, municipalities are required to submit annual statements of compliance to ARB by

January 31st of each year – either by submitting one statement signed by the municipality certifying compliance by its contractors or by submitting copies of the certification statements it received from its contractors.

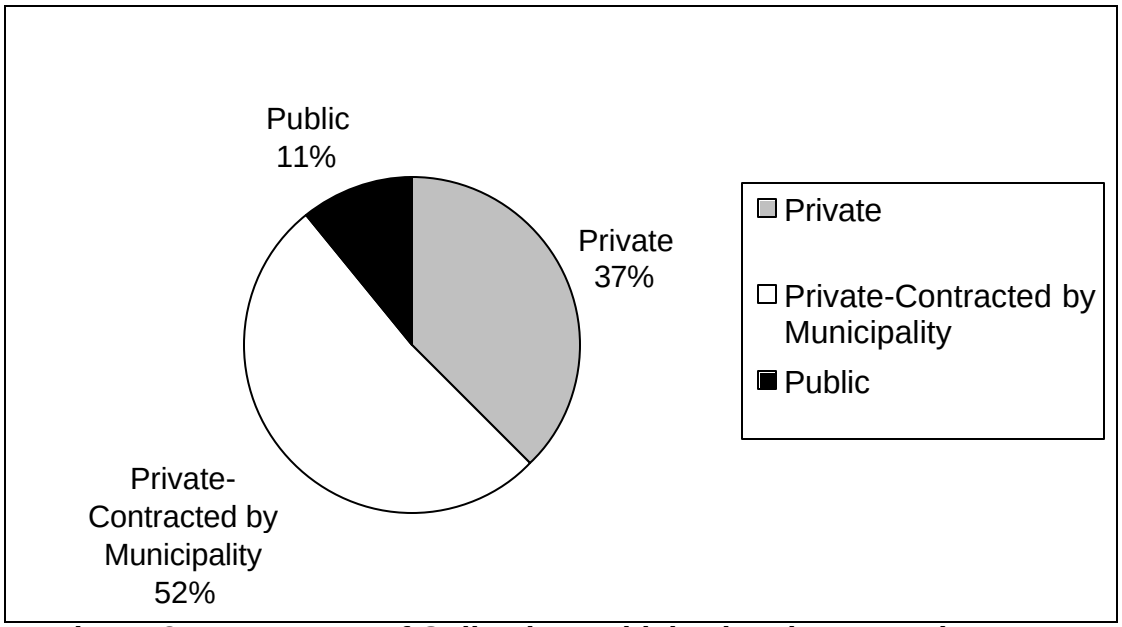

Figure 2. Percentage of Collection Vehicles by Fleet Type (From ARB Engine Survey).

When a municipality submits its annual report to ARB, staff will check to ensure all collection vehicle owners have stated they are in compliance with the regulation. If an owner has not submitted a signed compliance statement, ARB will investigate further. Staff may inspect the terminal and vehicles for compliance. If the owner is not in compliance, ARB may issue a notice of violation (NOV) or other document that requires the owner comply or face penalties. The contractor/owner is required to send the municipalities with whom they contract a copy of the non-compliance notification. ARB staff will also notify the municipality that one of its contractors is out of compliance with the regulation. ARB may also issue an NOV to the municipality for noncompliance by one of its contracted companies as non-compliance is a violation by both the vehicle owner and the municipality.

After January 31st of each year, if a municipality determines its contractor is out-of-compliance, the municipality must notify the Executive Officer of the determination within 30 days of discovery. Again, ARB will investigate and make a determination on issuance of an NOV. A municipality that knows its contractor is out of compliance and does not notify ARB within the required 30 days would be in violation of the proposed regulation.

The rule mandates all collection vehicle owners be in compliance by December 31, 2012, which includes any granted compliance extensions. Therefore, staff proposes municipalities submit their final reports on January 31, 2013. Following

that date, municipalities are still required to notify ARB of non-compliance by contractors, and ARB will continue to notify municipalities of significant non-compliance by owners.

To assist with reporting, staff plans to develop an Internet-based automated reporting form, which would be offered to municipalities as a mechanism to streamline reporting. Municipalities may, of course, submit reports via the mail, fax, or electronic mail using any format containing all required information in section 2021.1 (b).

C. Best Available Control Technology Requirement

This rule proposes an owner be prohibited from operating a fleet of collection vehicles unless the owner complies with this diesel PM control measure as of the applicable implementation dates. Compliance with the proposed regulation is determined by choosing the BACT option for each collection vehicle over a phased-in implementation schedule, and keeping records at the maintenance facility and on-board the vehicle for inspection.

BACT refers to three main compliance options: (1) use of an engine certified either alone or in combination with a DECS to the 0.01 g/bhp-hr PM standard, (2) an alternative-fuel or heavy-duty pilot-ignition engine, or (3) a DECS that receives verification according to title 13, CCR, section 2702 for a specified engine, and which the DECS manufacturer or authorized dealer agrees can be used on a specified engine and vehicle combination. Owners are required to use the highest level DECS verified for their engine and application at the time of retrofit.

An owner who chooses to use an engine certified to the 0.01 g/bhp-hr PM standard would use an engine certified to either the optional 0.01 g/bhp-hr particulate emission standard as specified in title 13, CCR, section 1956.8(a)(2), or the 0.01 g/bhp-hr particulate emission standard as specified in title 13, CCR, section 1956.8(a), when it becomes effective in 2007. This option has a greater cost, as it entails either purchasing a replacement vehicle or engine (also called engine repowering), but may be preferred by an owner when his vehicle's engine is nearing the end of its useful life. An engine certified to 0.01 g/bhp-hr PM, however, may not be available for collection vehicles until the 2007 MY.

No additional controls are required to reduce diesel PM emissions from alternative-fueled vehicles because, by definition, alternative-fuel vehicles do not emit diesel PM. A dual-fuel collection vehicle, however, which uses both diesel fuel and an alternative-fuel, is covered by the proposed rule, and thus would be required to comply with the proposed regulation as a diesel-fueled vehicle. A dual-fuel collection vehicle with a verified diesel particulate filter installed, for example, would be in compliance with this regulation. A heavy-duty pilot-ignition engine is treated like an alternative-fuel engine in this rule. This engine uses

diesel fuel in less than ten percent of its duty cycle for engine ignition and cannot operate or idle solely on diesel fuel at any time.

The third option is to install a verified DECS to meet the BACT requirement. This is a less expensive option that can be as effective in reducing diesel PM as installing an engine certified to the 0.01 g/bhp-hr PM standard if the technology used meets the Level 3 PM reduction requirements (**Table 7**). If an owner plans to comply using this option, he or she must install technology verified by ARB. Several DECS have received approval from ARB's Executive Officer under the Verification Procedure for In-Use Strategies to Control Emissions from Diesel Engines (title 13, CCR, sections 2700-2710). In this procedure diesel PM control devices can be verified to one of three levels of diesel PM reduction: Level 1, from 25 to 49 percent; Level 2, from 50 to 84 percent; and Level 3, 85 percent and greater. BACT is determined by Level, not by percent emission reduction. Thus a technology that reduces diesel PM by, for example, 45 percent is equivalent, under this rule, to one that reduces diesel PM by 25 percent. Both get the same credit as Level 1 DECSs.

Table 7. Potential Reductions from the Use of Diesel Emission Control Strategies.

Engine MYs	Particulate Standard (g/bhp-hr)	Maximum PM Emissions (gbhp-hr)		
		Level 3	Level 2	Level 1
1960 – 1987	None	85% reduction	50% reduction	25% reduction
1988 – 1990	0.6	0.09	0.30	0.45
1991 – 1993	0.25	0.04	0.13	0.19
1994 – 2006	0.1	0.02	0.05	0.08

The concept of BACT using a DECS can be further explained as follows. An owner must look for the highest level DECS that can be installed and operated successfully on each combination of an engine in a vehicle. If a Level 3 DECS is available for the engine, this option must be applied to the engine provided the DECS manufacturer or authorized dealer agrees that the DECS will work in that vehicle. If a Level 3 is not available or feasible, then a Level 2 option must be explored. A device verified to this level, for example, might be employed for those vehicles that do not have the appropriate PM to NOx ratio or exhaust temperature for a Level 3 DECS.

A Level 1 DECS is acceptable only if it is the only option available for the engine or application, with the exception that the oldest engines in Group 2 may not use Level 1 technology, unless the owner has fewer than 15 vehicles. If no DECS is verified and feasible, the owner may apply for an implementation delay, as discussed later, but will eventually have to repower or otherwise replace the engine with one meeting the 0.01 g/bhp-hr PM standard, an alternative fuel

engine, or a heavy-duty pilot ignition engine. Technologies to meet the BACT option are discussed in more details in the Technical Support Document.

D. Implementation Schedule

Staff proposes an implementation schedule designed with the goals of phasing-in implementation by technical feasibility and cost (**Table 8**).

Table 8. Implementation Schedule for Engine Model Years 1960 to 2006.

Group	Engine MY	Percentage of Group to Use Best Available Control Technology	Implementation Date
1	1988 – 2002	10	December 31, 2004
		25	December 31, 2005
		50	December 31, 2006
		100	December 31, 2007
2[a]	1960 – 1987	25	December 31, 2007
		50	December 31, 2008
		75	December 31, 2009
		100	December 31, 2010
3	2003 – 2006	50	December 31, 2009
		100	December 31, 2010

[a]Group 2: An owner of an active fleet with 15 or more collection vehicles may not use Level 1 technology as BACT (see section f.3.b.).

The first implementation group includes vehicles with MY 1988 through 2002 engines. In this group, the engines most likely to be successfully retrofitted with Level 3 DECS are MY 1994 to 2002 engines. ARB has already verified two types of Level 3 DECS for a number of engines in this group. The MY 1988 to 1993 engines are expected to be able to use either a Level 1 or Level 2 DECS, or to repower to a 0.01 g/bhp-hr PM emissions certified engine, or to use an alternative-fuel or heavy-duty pilot-ignition engine (see Technical Support Document for additional discussion). The repower may be accomplished through one of two means, either through the purchase of a new 2007 MY engine or through the installation of a 1994 to 2002 MY engine and a diesel particulate filter. Thus, the first group includes both engines that should achieve the highest emission reductions through application of a DECS and engines that have higher emissions and may either be retired or have lower level DECS applied.

In addition, based on ARB surveys of the industry, staff believes public and private fleets will be impacted equally in Group 1 (MY 1988 – 2002). Public and large private fleets tend to buy vehicles new and sell them to smaller companies after ten years. Since Group 1 includes both newer and older engines, the three fleet types should be impacted similarly.

The higher emitting, mechanical engines in the Group 2, MY 1960 to 1987 engines, are more difficult to retrofit with DECSs. The best means to reduce PM emissions from these vehicles may be to replace the engines with newer engines plus a Level 3 verified DECS. In other words, an owner could repower with a MY 1994 – 2002 engine and add a diesel particulate filter. Alternately, with engines this old, the best strategy may be a complete replacement. Group 2 engines are brought into compliance later than the Group 1 engines in order to allow additional time technology development and for owners to plan for engine replacement.

The use of Level 1 technology, however, is restricted in Group 2 engines. Owners with fewer than 15 collection vehicles would be allowed to use a Level 1 DECS, if any is available and verified, in addition to the options available to larger fleets. Owners of larger fleets are required to retire these engines or use Level 2 or 3 verified DECS by the end of 2010. The majority of diesel PM emissions from collection vehicles are produced by this engine model year group.

Group 3 engines, the newest engines with MYs 2003 to 2006, are to be brought into compliance by the end of 2010. This group comprises the smallest portion of the fleet in both vehicle numbers (nine percent of the total California collection vehicle fleet) and diesel PM emissions (two percent of total SWCV emissions). Staff anticipates Level 3 technologies to be verified for these MY engines in the future, although the use of exhaust gas recirculation (EGR) to reduce NOx emissions in these engines may make application of particulate filters challenging. The possibility also exists that one or more engine manufacturers could make 2007 emission standard compliant engines available for purchase before 2007.

A dual-fuel collection vehicle implements according to its model year. Any dual-fuel collection vehicle that has been retrofitted with a diesel particulate filter, for example to comply with the SCAQMD Rule 1193, is in compliance with the BACT requirement. Level 3 DECSs are currently verified for specific dual-fuel vehicles, thus owners should be able to comply with the proposed regulation according to the implementation schedule.

New technologies may be verified by ARB during the seven-year implementation period, resulting in additional Level 2 and 3 technologies available at lower cost, thus resulting in more cost-effective overall diesel PM emission reductions over time. Also, the possibility exists that 2007 emission standard compliant engines could be available for purchase earlier, if a heavy-duty diesel engine manufacturer made them available.

E. Calculating Active Fleet Size

The total number of vehicles comprising an owner's active fleet may vary from year to year because of new purchases and retirement of older vehicles, thus

complicating the calculation of the number of vehicles that must be in compliance each year. ARB staff, therefore, proposes to define the owner's active fleet in the following manner.

The active fleet comprises 1960 to 2006 engine MY residential and commercial collection vehicles with a manufacturer's gross vehicle weight rating greater than 14,000 pounds, including back-up or spare vehicles that accrue greater than 1000 miles per year, and is calculated by terminal. The owner may include alternative-fueled collection vehicles in this calculation.

To determine compliance with this phase-in, the owner must calculate active fleet size annually beginning January 1, 2004. In order to ensure equity regarding the locations of PM reductions and public exposure, the active fleet is calculated by terminal, not by an owner's entire fleet, which may be spread out through the state. Many of the larger companies operate out of multiple terminals, and the potential exists for a company to bring one entire terminal's fleet into compliance before another, which would lead to a neighborhood being exposed to higher diesel PM concentrations than the one brought into compliance first.

Two equations are used to calculate fleet size for any given year:

(1) TotVeh = Group%BACT * (#SWCV), and

(2) TotAddComp = TotVeh – TotComp,

where,
TotVeh = total number of collection vehicles required to be in compliance by the "Compliance Deadline,"
Group%BACT = "Percentage of Group to Use Best Available Control Technology" for the particular year,
#SWCV = sum of the number of collection vehicles in an engine model year group,
TotComp = total number of collection vehicles in compliance as of the calculation date, and
TotAddComp = total number of additional collection vehicles required to be brought into compliance before the next compliance deadline

If the TotAddComp is not equal to a whole number of collection vehicles, the owner is expected to round up to the nearest collection vehicle when the fractional part of TotAddComp is greater than or equal to one-half of a collection vehicle, and expected to round down to the nearest collection vehicle when the fractional part of TotAddComp is less than one-half of a collection vehicle.

Four active fleet size calculations are given below to illustrate various cases owners might experience. The first is a regular implementation schedule with no early implementation. The second is a fleet that implements early. The third is a fleet with fewer than four vehicles in a model year group. The fourth is a fleet

experiencing turnover with engines being retired and other engines being purchased.

1. Active Fleet Size Calculation – Regular Implementation Example

A fleet with 30 collection vehicles with a portion of vehicles in each engine model year group (**Table 9**) would implement using Equations (1) and (2) as calculated below.

Table 9. Regular Implementation Schedule Example.

Engine MY Group	January 1, 2004 Inventory (#SWCV)	Number of Collection Vehicles to Implement By December 31st of Each Year (TotAddComp)						
		2004	2005	2006	2007	2008	2009	2010
1	16	4	4	4	4	---	---	---
2	10	---	---	---	3	2	3	2
3	4	---	---	---	---	---	2	2

The fleet inventory does not change throughout the phase-in period. Therefore the #SWCV remains the same each year.

Since only engines in model year Group 1 are to be brought into compliance in 2004, 2005 and 2006, there is only one group to calculate for in 2004,
TotVeh = 0.25 * (16) = 4,
TotAddComp = 4 – 0 = 4.

In 2005, Group 1 continues to implement,
TotVeh = 0.5*(16) = 8,
TotAddComp = 8 – 4 = 4.

In 2006, Group 1 continues to implement,
TotVeh = 0.75*(16) = 12,
TotAddComp = 12 – 8 = 4.

In 2007, the calculation for engine model year Group 1 is the same,
TotVeh = 1*(16) = 16,
TotAddComp = 16 – 12 = 4.
But now Group 2 begins to implement, and, therefore, must also be calculated,
TotVeh = 0.25*(10) = 2.5 α 3 (The number of vehicles to implement must be rounded up to a whole number, when the fractional part of a vehicle is 0.5 or greater)
TotAddComp = 3 – 0 = 3.

In 2008, since engine model year Group 1 has finished implementing, the calculation is only for Group 2,
TotVeh = 0.5*(10) = 5,
TotAddComp = 2.

In 2009, Group 2 continues implementing,
TotVeh = 0.75*(10) = 7.5 α 8,
TotAddComp = 8 – 5 = 3,
And, Group 3 begins implementing,
TotVeh = 0.5*4 = 2,
TotAddComp = 2 – 0 = 2.

In 2010, Group 2 completes implementation,
TotVeh = 1*(10) = 10,
TotAddComp = 10 – 8 = 2,
As does Group 3,
TotVeh = 1*(4) = 4,
TotAddComp = 4 – 2 = 2.

2. Active Fleet Size Calculation – Early Implementation Example

A fleet with 30 collection vehicles with a portion of vehicles in each engine model year group that implements early (**Table 10**) would implement using Equations (1) and (2) as calculated below.

Table 10. Early Implementation Schedule Example.

Engine MY Group	January 1, 2004 Inventory (#SWCV)	Number of Collection Vehicles to Implemented By December 31st of Each Year (TotAddComp)								
		2004	2005	2006	2007	2008	2009	2010	2011	2012
1	16	12	---	---	---	---	4	---	---	---
2	10	---	---	5	---	---	3	---	---	2
3	4	---	---	---	---	---	2	2	---	---

The fleet inventory does not change throughout the phase-in period; therefore #SWCV remains the same each year. The owner implemented BACT on seventy-five percent of his Group 1 collection vehicles by December 31, 2004,

TotVeh = 0.75*(16) = 12,

so the owner could delay the 100 percent compliance deadline for Group 1 to December 31, 2009,

TotVeh = 1*(16) = 16,
TotAddComp = 16 – 12 = 4.

The owner also implemented BACT on fifty percent his Group 2 collection vehicles by December 31, 2006,

TotVeh = 0.5*(10) = 5.

The owner would still need to implement BACT on 75 percent of his Group 2 collection vehicles by December 31, 2009,

TotVeh = 0.75*(10) = 7.5 α 8
TotAddComp = 8 – 5 = 3.

The owner could delay the 100 percent compliance deadline for Group 2 to December 31, 2012,

TotVeh = 1*(10) = 10
TotAddComp = 10 – 8 = 2.

3. Active Fleet Size Calculation – Small Fleet Example

A fleet with fewer than four collection vehicles per engine model year group can ignore 25, 50 and 75 percent implementations and is only required to implement by the 100 percent implementation date for each engine model year group (**Table 11**). A fleet with three collection vehicles in engine model year Group 1 would implement all three vehicles by December 31, 2007. Likewise, a fleet with three collection vehicles in Groups 2 and 3, respectively, would implement bring all three vehicles into compliance by December 31, 2010.

Table 11. Small Fleet Example.

Engine MY Group	January 1, 2004 Inventory (#SWCV)	Number of Collection Vehicles to Implement By December 31st of Each Year (TotAddComp)						
		2004	2005	2006	2007	2008	2009	2010
1	3	---	---	---	3	---	---	---
2	3	---	---	---	---	---	---	3
3	3	---	---	---	---	---	---	3

4. Active Fleet Size Calculation – Fleet Turnover Example

A fleet with 30 collection vehicles with a portion of vehicles in each engine model year group (**Table 12**) and which changes its fleet composition over time would implement using Equations (1) and (2) as calculated below.

Table 12. Fleet Turnover Example.

Engine MY Group	January 1st Inventory of Each Year (#SWCV = #)/ Number of Collection Vehicles to Implement By December 31st of Each Year (TotAddComp = Tot)													
	2004		2005		2006		2007		2008		2009		2010	
	#	Tot	#	Tot	#	Tot	#	Tot	#	Tot	#	Tot	#	Tot
1	16	4	18	5	18	5	18	4	18	0	18	0	18	0
2	10	0	8	0	8	0	6	2	6	1	4	0	2	0
3	4	0	4	0	4	0	6	0	6	0	8	4	10	6

The fleet inventory changes throughout the phase-in period, but the total number of vehicles in the fleet remains at 30.

Since only engines in model year Group 1 are to be brought into compliance in 2004, 2005 and 2006, there is only one group to calculate for in 2004,

TotVeh = 0.25 * (16) = 4,
TotAddComp = 4 – 0 = 4.

In 2005, two vehicles are added to Group 1 and, therefore, implementation continues as follows,

TotVeh = 0.5*(18) = 9,
TotAddComp = 9 – 4 = 5.

In 2006, Group 1 continues to implement with the enhanced inventory,

TotVeh = 0.75*(18) = 13.5 α 14,
TotAddComp = 14 – 9 = 5.

In 2007, the calculation for engine model year Group 1 is the same,

TotVeh = 1*(18) = 18,
TotAddComp = 18 – 14 = 4.

But now Group 2 begins to implement, and, therefore, must also be calculated,

TotVeh = 0.25*(6) = 1.5 α 2 (The number of vehicles to implement must be rounded up to a whole number, when the fractional part of a vehicle is 0.5 or greater)
TotAddComp = 2 – 0 = 2.

In 2008, since engine model year Group 1 has finished implementing, the calculation is only for Group 2,

TotVeh = 0.5*(6) = 3,
TotAddComp = 3 – 2 = 1.

In 2009, Group 2 continues implementing,

TotVeh = 0.75*(4) = 3,
TotAddComp = 3 – 3 = 0,

and, Group 3 begins implementing,
TotVeh = 0.5*8 = 4,
TotAddComp = 4 – 0 = 4.

In 2010, Group 2 completes implementation,

TotVeh = 1*(2) = 2,
TotAddComp = 2 – 3 = -1 = 0.

As does Group 3,

TotVeh = 1*(10) = 10,
TotAddComp = 10 – 4 = 6.

Collection vehicles within one year of retirement would be exempt from compliance with the proposed regulation as described in the following section.

F. Compliance Extensions

Staff believes owners may experience conditions justifying a compliance extension. Three main categories of compliance extensions exist: early implementation, no verified DECS, and active fleets with fewer than four vehicles.

1. Early Implementation

Staff recognizes some companies have already made considerable efforts to reduce emissions from their vehicles through early application of BACT. Staff proposes to give some allowance to these fleets in the following two situations.

If an owner has applied BACT to 50 percent of the collection vehicles in Group 1 (MY 1988 – 2002) in his or her active fleet before December 31, 2004, the owner may delay 100 percent compliance of the Group 1 vehicles to December 31, 2009. Likewise, if an owner has applied BACT to 50 percent of the collection vehicles in Group 2 (MY 1960 – 1987) in his or her active fleet before December 31, 2006, the owner may delay 100 percent compliance of the Group 2 vehicles

to December 31, 2012. An owner who implements early will not be required to install a higher level DECS if one becomes available between the time the DECS is installed early and the mandated compliance date. A compliance extension for early implementation allows SWCV owners to stretch out implementation beyond required dates while at the same time implementing early in at least half of the vehicles. Owners may qualify for local funding based on early implementation because it is voluntary and occurs prior to the mandated implementation dates.

2. No Verified Diesel Emission Control Strategy

An owner may be granted a delay in implementing the BACT if no verified DECS exists for an engine and application. This delay recognizes the higher cost of an engine repower or replacement and provides the owner additional time to plan for this cost. In addition, during the time allowed for a delay, effective DECSs may become verified. Annual delays will be granted for a specified period of time only.

Two methods of granting delays are proposed. Either the Executive Officer would grant a blanket one-year compliance extension, or, if the owner has an engine not granted a blanket one-year compliance extension, the owner may apply for a compliance extension. Staff proposes if no DECS has been verified for a specific engine or application, or one is not commercially available, by ten months prior the implementation date for that group, then the Executive Officer may grant a one-year implementation delay without requiring documentation from the owner as to the unavailability of verified technology. Vehicle owners should look for this implementation delay on the ARB's website.

In the second case, a DECS could be verified for an engine, but not able to be used in a specific application. In this case, staff proposes an owner may apply no later than July 31st of the year for which he or she is requesting an extension. The owner must provide documentation that DECSs have been investigated and shown not to work on a particular engine or set of engines, or in the owner's vehicle application. Evidence convincing to ARB would include, for example, a letter from a DECS manufacturer showing evidence of data collected that demonstrates the DECS will not function on that particular vehicle because of its duty cycle. Other examples of justified reasons for an owner applying for an implementation delay would be if the owner has an engine in his fleet which is used in a small number of collection vehicles in California and for which no DECS has been verified, if the engine is under an original engine warranty and application of a DECS would void that warranty, or if a DECS is not commercially available. In these cases, the owner should provide sufficient documentation to validate the need for a delay.

ARB has an existing procedure for responding to requests for extension as codified in title 17, CCR, section 60030. When an extension is requested, the Executive Officer of the ARB will respond to the collection vehicle owner that the

application has been received within 30 days of receipt, and that it is "complete and accepted for filing or that the application is deficient and identify the specific information required to make the application complete." If additional information has been requested to complete the application, within 15 days of receipt of that information the Executive Officer will inform the collection vehicle owner of either acceptance of the application for filing or of another deficiency in the application. Within 90 days after the application is accepted for filing, the Executive Officer will issue her approval or disapproval of the compliance extension request.

Staff proposes, however, an owner not be granted extensions indefinitely. Staff proposes that if no DECS for a specific engine or application is available through 2007 for a Group 1 (MY 1988 – 2002) engine, the owner would be required to use one of the following BACT: an engine that achieves the 0.01 g/bhp-hr PM standard, or an alternative-fueled or heavy-duty pilot ignition engine, by December 31, 2008. Similarly, for Groups 2 (MY 1960 – 1987) and 3 (MY 2003-2006) collection vehicle engines, compliance extensions are not given for longer than to December 31, 2011. The owner would, therefore, be required to employ another BACT by December 31, 2011.

If an owner is granted a compliance extension for an engine, the owner should apply the best available technology options to the maximum number of vehicles that can be retrofitted up to the applicable percentage for each year. Thus, if the applicable phase-in percentage is 25 percent, and the owner has received compliance extensions for some engines, the owner is still required to apply BACT to 25 percent of his fleet that year if possible. In the final year of each group's phase-in, if the owner still has some engines for which a delay has been granted, the owner is allowed to delay until no more delays are available, at which time the engine would be required to be scrapped, repowered to the 0.01 g/bhp-hr standard, or converted to an alternative-fueled, or heavy duty pilot-ignition engine.

3. Active Fleet with Fewer than Four Vehicles

An owner with three or fewer collection vehicles in his or her active fleet would be able to delay the compliance deadline of any engine in Group 1 to December 31, 2007, and in Group 2 to December 31, 2010. No extensions will be granted for Group 3. The owner need not apply for this extension, but if requested to justify apparent non-compliance an owner would need to supply proof of the size of his or her active fleet to ARB enforcement personnel.

G. Diesel Emission Control Strategy Special Circumstances

Owners would be required to maintain BACT on each vehicle once that vehicle is in compliance. If the BACT is a DECS, an owner would not be required to upgrade to a higher level of DECS if the DECS is functioning as verified. The following special circumstances, however, would apply.

1. Failure or Damage of a Diesel Emission Control Strategy

For various reasons, a DECS might fail or be damaged during the lifetime of an engine. The intent of this regulation is to reduce diesel PM emissions for the life of an engine, therefore the owner is required to fix the failed or damaged DECS or install a new one. For heavy heavy-duty engines, ARB requires that DECS manufacturers provide, at a minimum, a commercial warranty of five years or 150,000 miles (title 13, CCR, section 2707). However, long-term usage on heavy-duty vehicles has shown DPFs to last for more than 400,000 miles and over four year, in some cases (Kimura 2003). The average collection vehicle mileage is 15,635 miles per year.[3]

Staff proposes if a DECS fails or is damaged while it is within its warranty period, the owner be allowed to repair or replace the DECS with the same or comparable DECS, as provided under the DECS manufacturer's warranty. If, however, the DECS fails or is damaged outside of its manufacturer-provided warranty, staff proposes the owner would be required to install the highest verified level DECS available. If the owner had previously installed a Level 1 (25%+) DECS, for example, and a Level 2 (50%+) or Level 3 (85%+) DECS is available, then the owner would be required to upgrade the DECS to the higher level DECS.

2. Discontinuation of Fuel as a Diesel Emission Control Strategy

If an owner chooses to discontinue use of fuel verified as a DECS under section 2021.2 (b)(3) of the proposed regulation, the owner would be required to use another BACT. In the event another BACT is not commercially available within 30 days from the date of discontinuation of a fuel verified as a DECS, the owner would be required to submit a compliance plan to the Executive Officer no later than 60 days after discontinuation of the use of the fuel verified as a DECS that demonstrates how the owner will bring his or her vehicles into compliance within six months. In other words, the owner is required to apply another BACT within 30 days unless no DECS is commercially available. In that case, the owner must comply within six months.

3. Level 1 Diesel Emission Control Strategy

While use of a Level 1 DECS is approved in most cases by this proposed regulation, the relatively low level of PM reduction (25 percent) is a concern. Widespread use of Level 1 DECS would not achieve the goals set forth in the DRRP (ARB 2000b) of 75 percent diesel PM reduction by 2010 and 85 percent diesel PM reduction by 2020. Staff realizes, however, in some cases a Level 1 device may be the only verified DECS for a specific engine and application.

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[3] ARB. 2001. Averages of survey of three solid waste collection vehicle companies.

Requiring immediate use of either an engine that meets the 0.01 g/bhp-hr PM standard or an alternative-fuel or heavy-duty pilot-ignition engine might be overly burdensome financially for the owner. As such, staff proposes a vehicle owner be allowed to use a Level 1 DECS for a limited time period as a BACT. The time limit for Group 1 (MY 1988 – 2002) is ten years.

The time limit on use of a Level 1 DECS for Group 2 (MY 1960-1987) for companies with fewer than 15 vehicles is also ten years, but this special circumstance may not be applicable as no Level 1 devices have been verified for Group 2 engines. If an owner has 15 or more vehicles in his or her active fleet, he or she may not use a Level 1 DECS on any Group 2 vehicle. If no DECS is verified or available for Group 2 vehicles, then the owner would be eligible to apply for a compliance extension, after which the owner would have to repower or replace the engine as per sections 2021.2 (b)(1) or (b)(2).

Staff proposes that the time limit for use of a Level 1 DECS on Group 3 (MY 2003-2006) vehicles be five years.

4. Engine Retirement

An owner may retire an engine, either by selling it outside of the State of California, scrapping the engine, or using it in a backup vehicle. If the engine is within one year of retirement as of the applicable compliance date, then staff proposes that the owner would not be required to install a DECS. Similarly, if an installed DECS fails and it cannot be repaired, the owner of a vehicle within one year of retirement would not be required to replace or upgrade the device. In order for ARB to determine, for enforcement purposes, this engine is going to be retired, the owner must maintain records both at the facility and on-board the vehicle stating the retirement date. Otherwise, the owner would be subject to enforcement for non-compliance. The owner would also be subject to enforcement if he then kept the vehicle in the active fleet after the stated retirement date and did not install the required DECS.

5. Use of Experimental Diesel Particulate Matter Emission Control Technology

An owner may want to participate in a demonstration of experimental technology designed to reduce diesel PM. This regulation requires the use of verified DECS, and by its nature an experimental technology will not have received verification. Staff, therefore, proposes an owner be allowed to install experimental technology on no more than ten vehicles at any time in his active fleet for testing and evaluation. Each vehicle being used for the demonstration would be deemed to be in compliance with this rule for the duration of the experiment, provided the experimental technology reduces diesel PM and a valid experimental permit has been obtained from ARB. At the termination of the experiment, the experimental technology should be removed, unless it has received appropriate verification

from ARB, and replaced with the verified DECS as required, within six months of termination of the experiment.

H. Record Keeping

ARB proposes that owners keep records and make those records available for inspection during enforcement audits by ARB personnel. Staff had previously proposed in preliminary drafts of this regulation that owners submit records of compliance to ARB, but has removed this requirement from the proposed regulation after considerable consultation with interested persons. Staff is now proposing only that owners maintain certain records, both at the terminal where the vehicle normally resides and in the vehicle. If an owner is found to be out of compliance with this regulation, enforcement may be taken against the owner.

1. Records Accessible at Terminal

Records to be kept at the terminal or facility where the vehicle normally resides include a list of the collection vehicles covered by the proposed regulation which identifies each vehicle type, engine manufacturer, engine model and engine model year. That information must be tied to specific DECS that are installed in each vehicle. DECS information includes the type of DECS, its serial number, manufacturer, model, level, and date of installation, or first date of use if a fuel DECS. If using a Level 1 or Level 2 verified DECS, the reason for choosing that DECS must also be provided. This could simply be a statement that no Level 3 verified DECS were available. If a Level 3 verified DECS is available, then the DECS manufacturer or authorized dealer must provide reasoning for not using that DECS. DECS maintenance records would also need to be available. In the case of fuel or fuel additives used as a DECS, purchase records would need to be kept for the most current two years worth of purchases.

Backup vehicles, engines with planned retirement within one year, and engines using experimental diesel PM DECS would need to be identified in the records as well. Each backup vehicle would need to have its vehicle identification number (VIN) and mileage recorded as of January 1st of each year beginning January 1, 2005. If the engine is exempt because it is to be retired within one year, the owner must have records of the retirement date tied to specific engine information, including VIN, engine manufacturer, engine model, and engine model year. Similarly, this specific engine information must be kept with documentation of the experimental program.

2. Records Kept in Vehicle

Staff also proposes owners be required to keep certain information in the vehicle, which can be accessed during roadside inspections. Numerous individuals have told staff that keeping information inside the vehicle is impractical, so ARB suggests a label with the required information be affixed to the driver's side door

jam, or in another readily accessible location known by the driver and readily visible to an inspector. Illegible or inaccessible records would not be acceptable. The information required is the same as that required under the Verification Procedure in section 2706 (g), which includes the manufacturer's name, address, and phone number; the DECS family name; product serial number, month and year of manufacture plus the date of installation of the DECS, or date of first use if the DECS is a fuel.

Staff has concluded that any inconvenience to owners of being required to have this information in the vehicle are out-weighed by the necessity for inspectors to have information available during a roadside inspection verifying the DECS has been installed. Otherwise, an inspector might have to dismantle a muffler housing, for example, to determine that a diesel particulate filter was installed. In addition, other regulations require certain records be kept in vehicles, such as manifests, therefore staff believes it is not unreasonable to require these records be kept in collection vehicles also.

I. Enforcement

A number of enforcement options exist with this regulation. The regulation may be enforced by ARB on the collection vehicle owner or a municipality. For collection vehicle owners, ARB staff may inspect the records kept at the facility and, if they find the fleet is in non-compliance with the regulation may impose penalties of up to $1000 per vehicle per day. If further investigation determines the fleet owner neglected or intended to violate the regulation, then up to $10,000 per vehicle per day may be imposed on the collection vehicle owner.

ARB may impose similar penalties against municipalities for contracting with collection vehicle owners in non-compliance with the regulation, or for not submitting reports or for submitting false statements in the reports. Municipalities may determine non-compliance either through lack of a signed statement of compliance from the collection vehicle owner, or through notice from ARB that a collection vehicle owner they contract with, permit, or license is in non-compliance, or through independent investigation by the municipality. Staff believes this mechanism is likely to be the most effective means to compel compliance, as the loss of a contract, permit, or license to operate and provide service would significantly impact an owner's ability to do business.

VI. AVAILABILITY AND TECHNOLOGICAL FEASIBILITY OF CONTROL MEASURE

Diesel engines have long been the engines of choice for use in collection vehicles because of the efficiency and durability of diesel engines, as well as the operators' familiarity with diesel engine technology. Historically, a lack of viable alternative-fuel engine technology for use in heavy-duty vehicle applications has also maintained the dominance of the diesel engines. Existing and emerging

technologies are making both alternative-fuel engines and diesel engines options for reducing toxic diesel PM emissions.

A. Availability of Best Available Control Technologies

Many options for reducing diesel PM emissions exist and are being developed in order to comply with this proposed regulation. Both hardware strategies, such as diesel particulate filters, diesel oxidation catalysts and repowering, and fuel and fuel additive solutions are explored in the Technical Support Document. In addition, the Technical Support Document discuses the in-use experience and status of verification for each of the technologies. ARB conducted extensive research into feasibility of these technologies in a number of studies, which are also discussed in the Technical Support Document and its appendices.

B. Availability of Diesel Fuel with 15 ppmw or Less Sulfur Content

The use of diesel fuel with 15 ppmw or less sulfur content ("low sulfur") will not be mandated prior to the 2006 national implementation date unless it's use is required as a condition of verification for specific DECSs to achieve the verified emission reductions. BP is the major producer and wholesaler of low sulfur diesel at this time and the fuel is currently available at two terminals in California, in Long Beach and Richmond. In response to market needs, BP has certified fuel resellers to handle the low sulfur fuel, thus making the product widely available in California by truck. BP is also selling low sulfur fuel through its ARCO stations that carry diesel fuel.

Other fuel refiners are considering selling this fuel, but have not yet made it available to the general market. This fuel will likely not be made available through the pipeline distribution system until July 2006, at which time, low sulfur diesel will be mandated to be available nationwide.

VII. REGULATORY ALTERNATIVES

No alternative considered by the ARB would be more effective in carrying out the purpose for which the regulation is proposed nor would be both as effective and least burdensome to affected private persons than the proposed regulation. A comparison of emission reductions from each regulatory alternative considered can be found at the end of this section (**Table 13**).

A. Do Not Adopt This Regulation

With full implementation of this control measure, the estimated reduction in diesel PM ranges from 72 to 81 percent in 2010, and from 67 to 82 percent in 2020, when compared to the not adopting this regulation (**Figure 3**). The recommended actions in this plan will have a great impact on reducing the localized risks associated with activities that expose nearby individuals to diesel

PM emissions. This diesel PM control measure will result in additional benefits associated with reducing diesel PM emissions, including reducing NOx emissions by 57 percent from baseline in 2010, reducing ambient fine PM levels, increasing visibility, reducing material damage due to soiling of surfaces, and reducing incidences of non-cancer health effects, such as bronchitis and asthma.

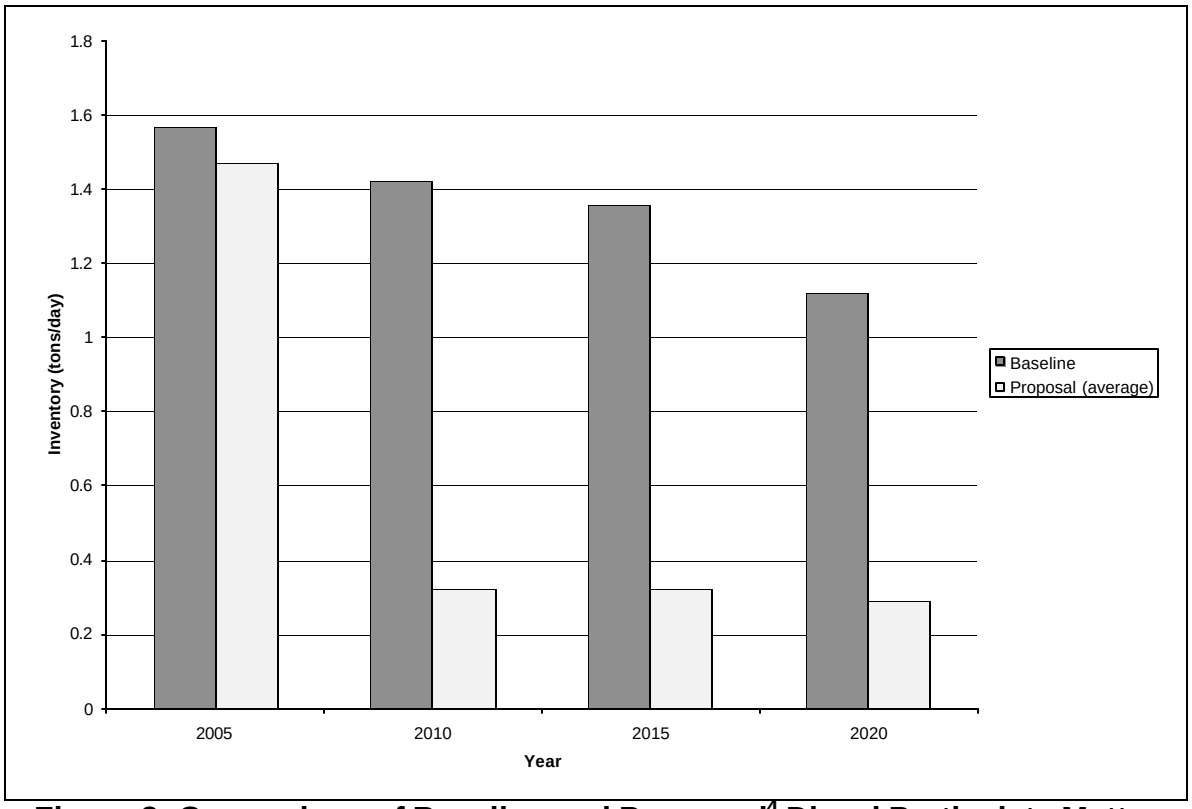

Figure 3. Comparison of Baseline and Proposed[4] Diesel Particulate Matter Inventory.

In not adopting this regulation ARB would be disregarding the potential risk posed by diesel PM. In consideration of the potential health impacts discussed earlier, and ARB's mandate to protect the public health of all Californians, this alternative is not considered a reasonable option. ARB staff does not recommend this alternative because it would result in approximately 80 percent greater PM emissions over the next few decades than the proposed plan, thus adversely impacting the health of Californians.

B. Rely Only on Local Regulations in the South Coast Air Quality Management District

As discussed earlier, the SCAQMD adopted Rule 1193, which requires collection vehicle owners to purchase only alternative-fuel or dual-fuel vehicles when

[4] The average of the three scenarios was used to construct this table.

replacing vehicles or adding to their fleets. SCAQMD estimated that in 2010 this rule will reduce diesel PM emissions by 68 tons per year (or 0.19 tpd) and NOx emissions by 695 tons per year (or 1.9 tpd) at a cost of $28,000 per ton of PM + NOx. The rule, however, only applies to vehicles operating in the South Coast Air Basin in fleets of 15 vehicles or more. Reliance on this rule would leave other parts of the state to continue to suffer from unacceptable diesel PM levels. In addition, because the rule does not address diesel PM emissions from current, in-use vehicles, reductions in diesel PM will occur too slowly. ARB staff does not, therefore, recommend this alternative because it would result in less diesel PM emission reductions and would be effective only in the South Coast Air Basin.

C. Rely on Federal Voluntary Program

The federal rules for new diesel engines will not begin to take effect for several years and do not affect existing vehicles. As discussed earlier, the U.S. EPA developed the Voluntary Diesel Retrofit Program to reduce diesel PM emissions in the immediate future. The program addresses pollution from diesel construction equipment and heavy-duty vehicles on the road today.

Although the U.S. EPA program is well suited for the nationwide needs of voluntary retrofit programs, it is not sufficient for meeting ARB's overall goals. The large number of diesel engines in California, over 1.2 million, makes reliance on a purely voluntary program unreasonable. ARB staff does not recommend this alternative because it would result in less diesel PM emission reductions.

D. Require all Collection Vehicles to Repower with Engines Certified to 0.01 g/bhp-hr Particulate Matter Standard in 2007

Another alternative staff considered, which would result in similar, if not greater, reductions in diesel PM emissions, is to require all collection vehicles to repower with diesel engines certified to the 0.01 g/bhp-hr particulate standard in 2007. This option is significantly more expensive than the proposed alternative. The estimated capital cost of repowering all engines in 2007 is approximately $501 million, which is a factor of ten above the $73 million expected to implement this proposed regulation, for a similar reduction in diesel PM. The estimated cost could be even higher than this as many vehicles cannot be repowered. A repower may be incompatible with older engine and drive train technology or the size of the engine compartment, thus the owner would have to purchase a new vehicle to accomplish the lower PM emissions. Nevertheless, some stakeholders have favored this option despite the higher cost.

Staff predicts a complete turnover of collection vehicles by 2020 would reduce diesel PM emissions by up to 90 percent as some owners would be eligible for a financial hardship exemption. This is an estimated reduction of 1.0 tpd, which is slightly higher than the recommended alternative in 2020 (**Table 13**). ARB staff

does not recommend mandating this as the sole option, however, because of the high cost of implementation compared to the amount of PM emissions reduced and significantly poorer cost effectiveness.

E. Require all Collection Vehicles to Convert to Alternative-Fuel Vehicles

Requiring all collection vehicles to repower or be replaced with alternative-fuel engines, such as LNG engines, would result in elimination of diesel PM emissions from these vehicles, with the exception of vehicles that might be exempted because of an incompatible duty cycle or financial hardship. This option is also significantly more expensive, costing $904 million for capital costs alone, over twelve times the $73 million total in capital and operation and maintenance (O & M) costs expected to implement this proposed regulation.

The amount of PM reduction would be slightly higher than the recommended alternative. If we assume 85 percent of collection vehicles convert to alternative-fuel by 2020, for example, the predicted emission reduction would be 0.95 tpd compared to the proposal predicted emission reduction of 0.83 tpd in 2020 (**Table 13**). ARB staff does not recommend this alternative because it would be significantly more costly than the recommended alternative without significantly increasing the amount of PM emissions reduced. In addition, growing evidence suggests that PM emissions from alternative fuel engines are not less hazardous than PM emissions from diesel engines.

F. Require Collection Vehicles to Use Diesel Oxidation Catalysts as of 2005.

Another alternative is to require relatively inexpensive DOCs on collection vehicles by 2005. ARB analysis concluded this option, while less expensive, would achieve minimal diesel PM reductions (**Table 13**) of less than 25 percent. Currently DOCs are only verified for 1991 and newer engines. This alternative would never result in the 75 to 85 percent reductions expected with the proposed regulation. ARB staff does not, therefore, recommend this alternative because it would produce less diesel PM emission reductions and not achieve the goal set in the Diesel Risk Reduction Plan.

Table 13. Diesel PM Reductions by Alternative Compared to the Proposal.

Year	Proposal (tpd)	Regulatory Alternatives Reductions (tpd)					
		Adopt Nothing	SCAQMD	Voluntary	Repower to 0.01	Repower to Alt Fuel	Require all DOC
2010	**1.1**	0	0.19	n.q	n.a	n.a	0.31
2020	**0.83**	0	n.q	n.q	1.0	0.95	0.24

n.q. – not quantified
n.a. – not applicable

VIII. ECONOMIC IMPACT

A. Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require state agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

State agencies are also required to estimate the cost or savings to any state or local agency and school districts in accordance with instruction adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the state.

B. Affected Manufacturers

Businesses that may be affected as a result of the proposed regulation include manufacturers of heavy heavy-duty diesel and alternative-fuel engines, collection vehicles, engine retrofit kits, DECS, and advanced, alternative-fuel technologies, such as CNG, LNG, dual-fuel and hybrid electric vehicles/engines. Since no collection vehicle engine or vehicle manufacturer, either diesel or alternative-fuel powered, is located in California, most impacts to these businesses, both positive and negative, will occur in other states.

As of March 2003, seven DECS manufacturers are located in California[5] and may be positively affected by this regulation. Some diesel, natural gas and dual-fuel collection vehicle assembly centers and distributors are located in California. Since some solid waste vehicle owners may choose to purchase new diesel or

[5] The seven companies based in California are Cleaire, Clean Air Partners, Extengine, GTAT California, KleenAir Systems, Olson Engineering, and Technical Associates. There may be additional companies unknown to ARB.

alternative-fuel collection vehicles as a means to meet the proposed regulation requirements, these manufacturers may experience a positive impact. Staff does not expect the proposed regulation to significantly influence owners' decisions on whether or not to purchase new vehicles though, as the difference in cost between a new vehicle and a DECS is very large. An owner may purchase a new vehicle sooner, rather than using a DECS, but staff does not expect this to be a large effect.

C. Estimated Costs to Collection Vehicle Owners

The proposed regulation would impose costs on private, government-contracted (publicly-contracted), and government (publicly-owned) residential and commercial solid waste collection fleets statewide because of the proposed requirement for diesel PM emission reduction. The following provides a summary of the costs to private and publicly-contracted companies for complying with the proposed regulation. The cost to publicly-owned agencies is discussed in section VII.H.

Under the proposed diesel PM control requirement, collection vehicle owners are responsible for selecting and implementing BACT. Publicly-owned agencies and larger private, both publicly-contracted and not publicly-contracted, companies typically turn over their fleets every five to ten years. The second owners of these collection vehicles are generally smaller private companies. Staff has, therefore, illustrated the cost using two scenarios: (1) a small private company with ten vehicles, and (2) a large private company with 100 vehicles.

1. Implementation Scenarios

The implementation schedule dictates a phase-in by fleet and engine model year (see **Table 8**). Staff assumed collection vehicle owners would choose the least expensive of the BACT options to comply with this regulation. Staff, therefore, assumed a DECS would be employed in lieu of more expensive options of repowering or replacing the vehicle or engine, whenever possible. PM emissions and exhaust temperatures dictate the type of DECS a collection vehicle can use. Based on available data on DECS currently available to the entire collection vehicle fleet, staff created three scenarios to determine economic impacts: the first is based on currently verified DECSs (**Table 14**), the second assumes no Level 2 DECSs are verified and is based on verifications of only Level 1 and 3 DECSs through the life of this rule (**Table 15**), and the third assumes that DECSs will be verified at all three levels (**Table 16**). All three of these scenarios are discussed in more detail in Section IV.B. and the Technical Support Document.

Table 14. Implementation Scenario (Current).

Group	Eng MY	%BACT	Implementation Date	Technology Option (By Percent Phase-In)				
				Level 1	Level 2	Level 3[a]	Repower	OE[h] 0.01
1	1994-2002[g] 32% of fleet	10%	12/31/2004	2.0%		8.0%		
		25%	12/31/2005	7.0%		8.0%		
		50%	12/31/2006	17.0%		8.0%		
		100%	12/31/2007	25.0%		5.0%	20.0%	
1	1991-1993[g] 14% of fleet	10%	12/31/2004	10.0%				
		25%	12/31/2005	15.0%				
		50%	12/31/2006	25.0%				
		100%	12/31/2007	30.0%			20.0%	
1	1988-1990[c] 18% of fleet	10%	12/31/2004					
		25%	12/31/2005					
		50%	12/31/2006					
		100%	12/31/2007				50.0%	
		Delay	12/31/2008				50.0%	
2	1960-1987[b] 27% of fleet	25%	12/31/2007				22.8%	
		50%	12/31/2008				22.8%	
		75%	12/31/2009				22.8%	
		100%	12/31/2010				22.8%	
		Delay	12/31/2011				9.0%	
3	2003-2006[d,e] 9% of fleet	50%	12/31/2009	14.1%		15.9%		20.0%
		100%	12/31/2010	14.1%		15.9%		20.0%
Percent of California's Collection Vehicle Fleet Total:				30%	0%	12%	54%	4%

Notes:

[a] Only 1994-2002 MY engines were considered for passive diesel particulate filters based on verification data. Assumption based on manufacturer with lowest engine exhaust temperature requirement.

[b] Nine percent of 1960-1986 vehicles are owned by companies with less than 15 vehicles (63 percent of surveyed companies).

[c] Assume all vehicles will repower and have BACT delays since no DECS are currently available.

[d] Assume current Level 3 verification will be extended to 2003-2006 MYs.

[e] Assume current Level 1 verification will be extended to 2003-2006 MYs.

[f] Assume small fleets (<15 vehicles) will have no DECS available and receive implementation delay to 2011.

[g] Assume 20 percent repower even though DECS currently available to these model years due to expected preference of some collection vehicle owners.

[h] Original equipment – purchased new.

Table 15. Implementation Scenario (Potential 1) - No Level 2 Verified.

Group	Eng MY	%BACT	Implementation Date	Technology Option (By Percent Phase-In)				
				Level 1	Level 2	Level 3[a]	Repower	OE[g] 0.01
1	1994-2002[f]	10%	12/31/2004	2.0%		8.0%		
	32% of fleet	25%	12/31/2005	7.0%		8.0%		
		50%	12/31/2006	17.0%		8.0%		
		100%	12/31/2007	25.0%		5.0%	20.0%	
1	1991-1993[c, f]	10%	12/31/2004	10.0%				
	14% of fleet	25%	12/31/2005	15.0%				
		50%	12/31/2006	25.0%				
		100%	12/31/2007	30.0%			20.0%	
1	1988-1990[c, f]	10%	12/31/2004	10.0%				
	18% of fleet	25%	12/31/2005	15.0%				
		50%	12/31/2006	25.0%				
		100%	12/31/2007	30.0%			20.0%	
2	1960-1987[b,c, f]	25%	12/31/2007	2.3%			22.8%	
	27% of fleet	50%	12/31/2008	2.3%			22.8%	
		75%	12/31/2009	2.3%			22.8%	
		100%	12/31/2010	2.3%			22.8%	
3	2003-2006[d,e]	50%	12/31/2009	14.0%		16.0%		20.0%
	9% of fleet	100%	12/31/2010	14.0%		16.0%		20.0%
Percent of California's Collection Vehicle Fleet Total:				47%	0%	12%	37%	4%

Notes:

[a] Only 1994-2002 MY engines were considered for passive diesel particulate filters based on verification data.

Assumption based on manufacturer with lowest engine exhaust temperature requirement.

[b] Nine percent of 1960-1986 vehicles are owned by companies with less than 15 vehicles (63 percent of surveyed companies).

[c] Assume current Level 1 verification will be extended to 1960-1993 MYs.

[d] Assume current Level 3 verification will be extended to 2003-2006 MYs.

[e] Assume current Level 1 verification will be extended to 2003-2006 MYs.

[f] Assume 20 percent repower even though DECS either currently or expected to be available to these model years due to expected preference of some collection vehicle owners.

[g] Original equipment – purchased new.

Table 16. Implementation Scenario (Potential 2) – All Levels Verified.

Group	Eng MY	%BACT	Implementation Date	Technology Option (By Percent Phase-In)				
				Level 1	Level 2	Level 3[a]	Repower	OE[h] 0.01
1	1994-2002[c, e] 32% of fleet	10%	12/31/2004		2.0%	8.0%		
		25%	12/31/2005		7.0%	8.0%		
		50%	12/31/2006		17.0%	8.0%		
		100%	12/31/2007		25.0%	5.0%	20.0%	
1	1991-1993[c,e] 14% of fleet	10%	12/31/2004		10.0%			
		25%	12/31/2005		15.0%			
		50%	12/31/2006		25.0%			
		100%	12/31/2007		30.0%		20.0%	
1	1988-1990[c,e,f] 18% of fleet	10%	12/31/2004	2.0%	8.0%			
		25%	12/31/2005	2.0%	13.0%			
		50%	12/31/2006	2.0%	23.0%			
		100%	12/31/2007	2.0%	28.0%		20.0%	
2	1960-1987[b,e,f] 27% of fleet	25%	12/31/2007	2.0%	0.25%		22.75%	
		50%	12/31/2008	2.0%	0.25%		22.75%	
		75%	12/31/2009	2.0%	0.25%		22.75%	
		100%	12/31/2010	2.0%	0.25%		22.75%	
3	2003-2006[d,e] 9% of fleet	50%	12/31/2009		14.0%	16.0%		20.0%
		100%	12/31/2010		14.0%	16.0%		20.0%
Percent of California's Collection Vehicle Fleet Total:				4%	43%	12%	37%	4%

Notes:
[a] Only 1994-2002 MY engines were considered for passive diesel particulate filters based on verification data. Assumption based on manufacturer with lowest engine exhaust temperature requirement.
[b] Nine percent of 1960-1986 vehicles are owned by companies with less than 15 vehicles. (63 percent of surveyed companies.)
[c] Assume 20 percent repower even though DECS currently or expected to be available to these model years due to expected preference of some collection vehicle owners.
[d] Assume current Level 3 verification will be extended to 2003-2006 MYs.
[e] Assume a PuriNOx+DOC Level 2 could be verified for all model years.
[f] Assume a small percentage of fleet may not be able to use Level 2 devices.
[g] Assume low sulfur fuel used for only installed diesel particulate filters before 2006.
[h] Original equipment – purchased new.

2. Implementation Costs

The initial cost per truck will vary depending on the BACT used for the truck. The initial costs listed in this section are based on capital and O & M costs applied to the scenarios. Staff assumed that a vehicle owner would use the least cost alternative for compliance and attributed that cost to the rule. Capital costs per vehicle and technology for various DECS options are listed in **Table 17**. Staff assumed no capital cost would be required for collection vehicle owners that used the fuel-water emulsion option. O & M costs will be higher from fiscal years

2004 to 2005 to account for the incremental costs of fuel and fuel transportation (**Table 18**) for the diesel particulate filters and oxidation catalysts that will be required to use low sulfur diesel fuel. After July 1, 2006, this added cost will disappear, because the federal low sulfur diesel fuel rule will mandate low sulfur fuel for use by all on-road diesel vehicles and, therefore, no incremental costs are associated with its use. Costs to vehicle owners will vary depending on individual company implementation schedules.

Table 17. Average Capital Costs for Diesel Emission Control Strategies.

	Average Cost ($)		
Cost Description	**Passive Diesel Particulate Filter** [a, b]	**Active Diesel Particulate Filter** [e,f]	**Diesel Oxidation Catalyst** [g,h,I,j]
Device	3,980	10,500	2,830
Installation[c, d]	290	290	290
Engine Backpressure Monitor [k]	1,000	1,000	0
Total Cost:	$5,260	$11,790	$3,120

Note: Costs and how they are derived are described in detail in Appendix F.
[a]MECA, November 2000, Study of DECS costs. 100-500 hp for varying production costs.
[b] U.S. EPA, May 2000, Draft RIA. Cost in 2007, pg. V-9.
[c]U.S. EPA, May 2000, Draft RIA. Includes trap cost, labor, warranty and muffler removal savings.
[d]ARB, June 2001. Installation cost for a muffler through phone conversations with Cummins, Golden State Ford Truck Sales, Caterpillar, and Performance Truck and Diesel.
[e]ARB, 2002. Cost to ARB demonstration program (device plus regeneration unit)
[f] ARB, October 2001. Cost quoted to ARB at Oct. 2001 meeting with active diesel particulate filters providers from Europe
[g]MECA, March 2000. Emission Control Retrofit of Diesel-Fueled Vehicles.
[h]Clean Air Counts, 2002.
[i]Fuelstar, 2000.
[j]Parsons, February 2001.
[k]Cost given at September 4-5, 2001 workshop by MECA members.

Table 18. Incremental Operation and Maintenance Costs for a Retrofitted Collection Vehicle.

	Average Cost for Passive and Active DPF and DOC ($)		Average Cost for Fuel-Water Emulsion ($)
Cost Description	**FY 2004 to 2005**	**FY 2006 and beyond**	**FY 2004 and beyond**
Increased Maintenance/Cleaning - 1 hour	80[a]	80	0
Incremental Fuel	200[b]	0	2,750 [d]
Incremental Fuel Transportation	230[c]	0	0
Total:	$510	$80	$2,750

Note: Costs and how they are derived are described in detail in Appendix F.
[a]Johnson Matthey Guidelines and phone conversation on 6/12/01; MECA meeting 5/19/2001.
[b]Diesel Fuel News, 5/14/01, Vol. 5(10); U.S. EPA, 5/00, Draft RIA.; BP, 6/21/01, meeting.
[c]Benetto, Inc., June, 20 2001.; Diamond Truck Lines. June 20, 2001.
[d]ARB, 2002. Cost quoted to ARB Verification Program.

The cost to repower an engine to meet a 0.01 g/bhp-hr PM emission standard (2007 or later MY) will vary according to the engine model year and vehicle type from which it is being converted. Replacing an electronically-controlled fuel injection engine (1994 and newer MYs) with a 2007 or later MY engine is expected to cost less than replacing a mechanically-controlled fuel injection engine of earlier vintage due to the challenges associated with conversion of mechanical to electronic systems. In some instances it may not be possible to upgrade engines because of space constraints in the engine compartment of the vehicle. An owner would, therefore, need to consider using a DECS or replacing the entire vehicle. In other cases it may be more cost effective to comply by replacing a pre-1994 MY engine with a 1994 to 2006 MY engine and installing a diesel particulate filter.

To determine the costs associated with repowering an engine to meet the 0.01 g/bhp-hr PM emission standard ARB staff surveyed engine providers. Based on the data, the average total cost is $45,000, with a range of $21,000 to $90,000, depending on the engine manufacturer, model, and model year. A DECS, likely a diesel particulate filter, will also be required, which brings the average cost to $50,000 (**Table 19**).

Table 19. Engine Repower.

New Engine Plus Installation	Cost
Average Cost of Repower	$45,000
Average Cost of DECS	$5,000
Average Total Cost:	**$50,000**

While not quantified, two benefits offset the initial cost of repowering an engine, increased fuel economy and decreased maintenance costs. The fuel economy

benefit will vary depending on the engine replaced, but as collection vehicles typically achieve only two to three miles per gallon, any fuel economy benefit would result in a significant savings, helping the owner recoup the costs associated with the repower. Similarly, decreased maintenance would result in increased time on the road and fewer repair costs, thus reducing repower costs.

D. Potential Impact on Small Businesses

Staff calculated the average cost for a small fleet of ten vehicles, the typical sized fleet of collection vehicles in California. Staff assumed 80 percent of the vehicles would fall under Group 1 (MY 1988 – 2002), and 20 percent of the vehicles would fall under Group 2 (MY 1960 – 1987) implementation phase-in. For comparison, staff also calculated the average cost for a large fleet of 100 collection vehicles. For the large company staff assumed 80 percent of the vehicles would fall under Group 1, and 20 percent under Group 3 (MY 2003 – 2006) implementation phase-in, because larger companies are assumed to only keep vehicles for five to ten years. The average total estimated costs for a large and small private company to implement this regulation between fiscal years 2004 and 2010[6] are $420,000 and $47,600, respectively (**Table 20**).

[6] Assumes costs paid for during the year leading up to December 31st implementation.

Table 20. Estimated Average Cost to a Small or Large Fleet Collection Vehicle Owner Based on the Average of Three Implementation Scenarios.

Fleet	Number of Vehicles Retrofit	Calendar Years	Discounted Annual Capital Costs [a]	Average Annual O&M Costs [b]	Total Average Annual Cost
Small					
	Varies	2004 – 2005	$100	$600	$700
	Varies	2005 – 2006	$300	$2,200	$2,500
	Varies	2006 – 2007	$400	$4,000	$4,400
	Varies	2007 – 2008	$2,600	$4,400	$7,000
	Varies	2008 – 2009	$5,700	$4,100	$9,800
	Varies	2009 – 2010	$5,700	$3,900	$9,600
	Varies	2010 – 2011	$10,000	$3,600	$13,600
	10	Total:	$24,800	$22,800	$47,600
Large					
	Varies	2004 – 2005	$2,000	$2,000	$4,000
	Varies	2005 – 2006	$5,000	$14,000	$19,000
	Varies	2006 – 2007	$9,000	$29,000	$38,000
	Varies	2007 – 2008	$55,000	$32,000	$87,000
	Varies	2008 – 2009	$52,000	$29,000	$81,000
	Varies	2009 – 2010	$62,000	$29,000	$91,000
	Varies	2010 – 2011	$70,000	$29,000	$99,000
	100	Total	$255,000	$164,000	$419,000

[a] Derived from capital costs using A = (Net Present Value)*(Capital Recovery Factor of 0.07).
[b] Discounted average annual O&M costs for fiscal years 2004 and 2005, include incremental fuel and fuel transportation costs for those vehicle using DECS requiring low sulfur diesel fuel.

As described in the cost effectiveness methodology (Appendix F), in order to translate the capital costs into annualized capital costs, staff used the cost recovery factor of 0.07[7]. For a small fleet of ten collection vehicles, including both annualized capital, such as the DECS, and O & M costs, such as fuel, the average total cost over the implementation phase-in period from fiscal year 2004 to 2010 would range from a minimum of $29,600 to a maximum of $77,400 and have an average total cost of $47,600. For a large fleet of 100 collection vehicles, the total cost would range from $236,000 to $728,000 with an average cost of $419,000. This accounts for variability found in implementing a full range of BACT as discussed in the implementation scenarios based on Current, Potential 1 and Potential 2 verification of DECS.

[7] Capital recovery factor is r(1+r)^N/[(1+r)^N-1] (Linsley, 1977), where r = 0.07 discount rate, and N = 5 years.

E. Potential Impact on Businesses

The regulation allows collection vehicle owners a variety of options to meet the proposed regulation requirements. The proposed regulation may have some cost impact on companies involved in the manufacture and production of engines and collection vehicles by creating the need for new engines and vehicles. The regulation may also impact fuel distributors because it requires early usage of low sulfur diesel fuel. Currently, no solid waste collection engine manufacturers and no solid waste vehicle chassis manufacturers are located in California.

Two solid waste vehicle body manufacturers are located in California. No cost to these manufacturers would exist, although they may experience benefits from increased business due to a potential increase in purchase of new vehicles as a means to meet BACT. Costs to comply with this diesel PM control measure would be borne by the collection vehicle owner. These manufacturers may choose to reduce diesel PM emissions voluntarily by installing DECS before selling new and used vehicles and engines to vehicle owners, but staff expects they would charge for the installation. Specific to the retrofit requirements, California businesses capable of performing engine retrofits will be positively affected with increased workload. As well, the seven DECS manufacturers located in California may be positively affected by this regulation.

F. Potential Impact on Business Competitiveness

The proposed regulation is not expected to impact the ability of California businesses to compete with businesses in other states. As indicated above, many of the businesses that produce the products needed to meet the proposal are located in other states. By requiring new, clean technology, this proposal may actually provide new opportunities for California businesses engaged in advanced technology.

Solid waste collection is, in general, an intrastate activity. Recycling is not. By restricting the scope to residential and commercial collection vehicles in this regulation and not transfer vehicles, staff is attempting to ensure interstate recycling companies will not be adversely affected or unable to compete in the recycling market. Staff also attempted to minimize adverse effects on intrastate business competitiveness by allowing for phase-in of the requirements, giving all vehicle owners time to budget for compliance.

G. Potential Impact on Employment

The proposed regulation will likely create a market for manufacturers of heavy-duty diesel or natural gas solid waste collection engines, vehicles, and emission control systems. For those businesses located in California, the creation of new

jobs is expected to meet this demand. Services to retrofit existing collection vehicles are expected to create new opportunities for existing businesses.

H. Potential Impact on Business Creation, Elimination or Expansion

The proposed regulation could impact California companies involved in the manufacture and production of engines, collection vehicles, and DECS. Currently, no solid waste engine or vehicle chassis manufacturers, two collection vehicle body manufacturers, and seven DECS manufacturers are located in California. Allowing new, cleaner engine and collection vehicle purchases as a means to meet the diesel PM control measure could create new business opportunities for manufacturers of heavy-duty diesel or natural gas bus engines, collection vehicles, and DECS. While most businesses that could benefit from the increased business are located outside of California, the total impact on California business will be determined by the extent to which these companies choose to expand in California. This expansion is a result of the expected new business opportunities created by the need for cleaner transportation technologies.

Staff believes this regulation would not significantly impact independent fuel distribution companies. Collection vehicles represent only one percent of the entire diesel-fueled fleet in California and use relatively few gallons of diesel fuel annually in comparison to other fleets.

I. Potential Costs to Local and State Agencies

The proposed regulation is expected to have an impact on public agencies statewide that contract with or own solid waste collection fleets. The following provides a summary of the costs to agencies for complying with the proposed regulation.

Under the proposed requirements, agencies are responsible for installing BACT. Since most public fleets have a fleet turnover rate of about five to seven years, we assumed 80 percent of the vehicles would fall under Group 1, and 20 percent of the vehicles under Group 3. From our inventory of collection vehicles, a total of 1,280 collection vehicles are owned by public agencies; 56 by state agencies (California Department of Transportation or Caltrans), six by federal military agencies, and the remainder by local agencies, such as city and county governments. Based on our vehicle and engine survey, the average number of vehicles owned by public agencies affected by this regulation is 55.

Caltrans and federal agencies will likely not be affected by this regulation as it only applies to those agencies that collect residential and commercial solid waste for a fee. The total estimated statewide cost for local government agencies with solid waste collection fleets would range from $2,869,000 to $8,863,000 with a total average cost of $5,114,000 (**Table 21**) over the entire implementation

phase-in period for the three implementation scenarios based on Current, Potential 1, and Potential 2 verification scenarios.

Table 21. Total Estimated Statewide Cost for Local Government Agencies Based on the Average of Three Implementation Scenarios.

Fiscal Year	Discounted Annual Capital Costs [a]	Average Annual O&M Costs [b]	Total Average Annual Cost
2004 – 2005	$29,000	$30,000	$59,000
2005 – 2006	$63,000	$165,000	$228,000
2006 – 2007	$106,000	$356,000	$462,000
2007 – 2008	$667,000	$384,000	$1,051,000
2008 – 2009	$637,000	$359,000	$996,000
2009 – 2010	$751,000	$359,000	$1,110,000
2010 – 2011	$850,000	$358,000	$1,208,000
TOTAL	$3,103,000	$2,011,000	$5,114,000

For public agencies that contract with private solid waste collection companies, an increase in the contract cost may occur within the terms of the contract or at the renewal of the contract.

J. Cost to the Average Household Receiving Waste Collection Service

Municipalities, or collection vehicles owners directly, are expected to pass through the cost to implement the proposed regulation on to ratepayers. The total cost per household in California, over the implementation period of fiscal year 2004 to 2010, would be approximately $5.90, or $0.85 annually. This figure was derived from dividing the total statewide dollar costs that businesses and individuals may incur from this proposed regulation over its lifetime of about $73,100,000 by the number of estimated households in California from fiscal year 2004 to 2010, or 12,500,000 households (Center for Continuing Study of the California Economy 2001).

IX. Environmental Impacts and Cost-Effectiveness

The proposed regulation would provide significant cost-effective diesel PM emission reductions throughout California, especially at the neighborhood level. The air quality benefits statewide would be not only from reduction of diesel PM emissions, but also from reduction of NOx, HC, and CO emissions as well. For the purposes of the cost effectiveness analysis, staff not only considered the benefits of reducing diesel PM, but also the benefits from reducing HC and NOx emissions. Furthermore, cancer risk as a result of exposure to diesel PM will be reduced by a factor of ten from a high of about 31 cases per million to about three in a million in the highest exposed areas (See Section III. F.). In determining costs associated with air quality benefits, staff relied on the results of

an extensive survey of the solid waste management industry and queries of the DMV database.

A. Benefits

1. Statewide Benefits

ARB staff estimates the proposed diesel PM control measure would result in the reduction of between 1.03 and 1.15 tpd of diesel PM emissions in 2010 and between 0.75 and 0.91 tpd diesel PM reduced in 2020 (**Table 22**). The reduction of diesel PM emissions attributed to this regulation peaks around 2010 because all collection vehicles are expected to meet the diesel PM control measure by 2010. After 2010 the benefits attributed to this regulation decline to between 0.75 and 0.91 tpd in 2020 as vehicles are retired and replaced with new engines that meet the federal 2007 0.01 g/bhp-hr PM standard.

Table 22. Statewide Diesel PM Emission Reduction Benefits.

Calendar Year	Baseline Inventory (tpd)	Diesel PM Reduction (tpd)		
		Current	Potential 1	Potential 2
2005	1.57	0.05	0.09	0.15
2010	1.42	1.15	1.03	1.12
2015	1.36	1.16	0.97	1.06
2020	1.12	0.91	0.75	0.84

Other air quality benefits also exist as a result of the use of the various BACT, including reduced emissions of CO, HC, and NOx. The reductions in HC are also accounted for in the State Implementation Plan. Based on expected reduction capabilities from the various DECS that might be used (**Table 23**), reductions of up to 9.44 tons of CO per day (**Table 24**), 3.69 tons of HC per day (**Table 25**), and 20.5 tons of NOx per day (**Table 26**) are predicted.

Table 23. Other Pollutant Potential Reductions from Diesel Emission Control Strategies.

Diesel Emission Control Strategy	Emission Reduction (Percent)			
	PM	CO	HC	NO_x
Passive Diesel Particulate Filter	85[a]	90[b]	95[b]	0[c]
Fuel-Water Emulsion[h]	50[a]	35[d]	60[d]	50[d]
Average Diesel Oxidation Catalyst	25[a]	47[e, f]	76[e, f]	0[c]

[a]Verified Level Reduction Goals for ARB. Strategies will not be verified without meeting this standard at a minimum.
[b]Allansson, R, Cooper, BJ, Thoss, JE, Uusimaki, A, Walker, AP, Warren, JP, 2001, European Experience of High Mileage Durability of Continuously Regenerating Diesel Particulate Filter Technology. SAE. 2001-01-0480.
[c]Majewski, W. Addy, 2001, Diesel Net Technology Guide: Diesel Particulate Traps. www.dieselnet.com.
[d]Diesel Net Technology Guide: Emission Control Technologies, 1998. www.dieselnet.com.
[e]Diesel Net Technology Guide: Diesel Oxidation Catalyst, 1999. www.dieselnet.com.
[f]Khair, Magdi; McKinnon, Dale L. Performance Evaluation of Advanced Emission Control Technonlogies for Diesel Heavy-Duty Engines. SAE. 1999-01-3564.
[h]Fuel-water emulsion increases CO and HC emissions. Although can be verified alone for the purposes of simplifying calculations, assumed it would be used in conjunction with a diesel oxidation catalyst to decrease impact of increase. Choose least decrease to account for offset of increase from fuel-water emulsion.

Table 24. Statewide Diesel Carbon Monoxide Emission Reduction Benefits.

Calendar Year	Baseline Inventory (tpd)	Diesel CO Reduction (tpd)		
		Current	Potential 1	Potential 2
2005	11.9	0.70	1.20	0.80
2010	11.8	9.11	9.44	8.86
2015	11.5	9.24	9.02	8.23
2020	9.59	7.15	7.00	6.44

Table 25. Statewide Diesel Hydrocarbon Emission Reduction Benefits.

Calendar Year	Baseline Inventory (tpd)	Diesel HC Reduction (tpd)		
		Current	Potential 1	Potential 2
2005	4.20	0.27	0.45	0.38
2010	4.10	3.45	3.69	3.55
2015	3.90	3.49	3.45	3.35
2020	3.04	2.59	2.60	2.50

Table 26. Statewide Diesel Oxides of Nitrogen Emission Reduction Benefits.

Calendar Year	Baseline Inventory (tpd)	Diesel NOx Reduction (tpd)		
		Current	Potential 1	Potential 2
2005	33.8	0	0	0
2010	27.4	16.2	13.0	18.1
2015	31.5	19.3	14.6	20.5
2020	27.5	15.6	11.3	17.0

2. Impacts on the State Implementation Plan for PM_{10}

The anticipated benefits of this proposed rule is part of the draft State Implementation Plan (SIP) for PM_{10} in the San Joaquin Valley. That plan is scheduled for adoption in June 2003, with attainment of the federal PM_{10} standard projected by 2010. As a "serious" nonattainment area, the San Joaquin Valley must use best available control measures for all sources of PM_{10} in its district and must also achieve five percent annual emission reductions in PM_{10} and its precursors. The San Joaquin Valley has seven percent of the statewide solid waste collection vehicles and will see a benefit of 0.07 to 0.08 tpd of PM reduced by 2010. In addition, the NOx and volatile organic carbon (VOC) benefits of the proposed rule are contained in the plan, as they are precursors to secondary PM formation.

The South Coast air basin is also classified as "serious" for PM_{10} but it attainment deadline is 2006, before most of the benefits of the proposed rule will be achieved. Nonetheless, the proposed rule will help that District maintain compliance with the federal PM_{10} standard. The rule also serves as a down payment on future plans to achieve the federal $PM_{2.5}$ standards and California's own, more stringent standards. Thirty-five percent of California's solid waste collection vehicles are in the South Coast region. By 2010, the proposed rule will reduce emissions from those vehicles by 0.36 to 0.40 tpd.

All other PM_{10} nonattainment areas in California will benefit from the proposed rule in a general way. Every district buy Lake County is nonattainment for the California PM_{10} standard. In addition, four other areas in California are nonattainment for the federal PM_{10} standards: Owens Valley, Searles Valley, Coachella Valley, and Imperial Valley.

For ozone SIPs there is a similar situation. The South Coast and San Joaquin Valley have new federal ozone plans under development, with adoption tentatively scheduled for September 2003 and December 2003, respectively.

Both districts have an attainment deadline of 2010 for the federal one-hour ozone standard. The overall NOx and VOC benefits of ARB's planned diesel in-use PM reduction rules are contained in the draft South Coast ozone plan and will be included in the San Joaquin Valley ozone plan once it is released for public review. The Sacramento Metropolitan region is considering an ozone plan update and would include ARB's diesel in-use PM reduction control measures if its attainment deadline ultimately shifts from 2005 to 2010.

As with PM_{10}, all other ozone nonattainment areas in California will benefit from the proposed rule in a general way as it reduces the precursors to ozone formation (see **Tables 25 and 26**).

3. Cost-Effectiveness of Proposed Regulation

The estimated average cost-effectiveness of this proposed diesel PM emission reduction regulation, considering only the benefits of reducing diesel PM, is approximately $28/lb of PM reduced annually from fiscal years 2004 to 2010. This rule will also result in significant emission reductions of HC and NOx, however, thus it is valid to allocate half of the cost of compliance to the benefits of HC and NOx reduction. The cost-effectiveness for reducing HC and NOx, which are ozone precursors and contributors to secondary PM formation, is $0.71/lb HC+NOx. The cost-effectiveness of PM reduction declines to $13/lb when half of the cost of compliance is allocated to HC+NOx reduction in this way. The costs and emission reductions associated with this regulation and how they were derived are discussed in Appendix F. Both capital costs, such as the purchase and installation of a DECS or new engine, and O & M costs, such as incremental fuel cost for low sulfur diesel fuel, are included in this analysis.

The cost-effectiveness of this regulation is consistent with the predicted costs associated with other regulations. Other California mobile source regulations adopted over the past decade had cost-effectiveness values ranging from $0.17 to $2.55/lb of ozone precursors reduced. The cost-effectiveness of the fleet rule for transit agencies, which calculated the cost effectiveness by allocating all of the costs to reducing diesel PM, was $25/lb of PM reduced.

B. Potential Negative Impacts

Certain potential negative impacts could be associated with elements of this proposed regulation. Those potential negative impacts are discussed below.

1. Creation Of Nitrogen Dioxide By Passive Catalyzed Diesel Particulate Filters

Measurements of NO_X emissions for heavy-duty diesel vehicles equipped with passive catalyzed filters have shown an increase in the portion of NO_2 emissions in total NO_X emissions, although the total NO_X emissions remain approximately

the same. The passive catalyzed filters oxidize some of the nitrogen oxide (NO) emissions to NO_2 to burn soot captured in the filter. More NO_2 is created than is actually being used in the regeneration process; and the excess is emitted. The NO_2 to NO_X ratios could range from 20 to 70 percent, depending on factors such as the diesel particulate filter systems, sulfur level in diesel fuel, and the duty cycle (DaMassa 2002).

Formation of NO_2 is a concern because it irritates the lungs and lowers resistance to respiratory infections. Individuals with respiratory problems, such as asthma, are more susceptible to the effects. In young children, nitrogen dioxide may also impair lung development.

In addition, even though a relatively small portion of collection vehicles are expected to use diesel particulate filters, model simulations based on a 90 percent market penetration of diesel particulate filters with assumed NO_2 to NOx ratios at 15, 20, 25, 30, and 50 percent, found a NO_2 to NO_X emission ratio of approximately 20 percent would nearly eliminate any impact of increased NO_2 emissions (ARB, 2002a; **Table 27**). According to the model, at the NO_2 to NOx ratio of 20 percent, there will be a decrease of the 24-hour ozone exposure (greater than 90 parts per billion) by two percent while an increase of the peak 1-hour NO_2 by six percent (which is still within the NO_2 standard). The health benefits derived from the use of PM filters are immediate and offset the possible adverse effects of increases in NO_2 emissions. For this reason, a cap of 20 percent NO_2 to NO_X emission ratio was established for all DECSs through ARB's Verification Procedure.

Table 27. Summary of Potential Impact from Modeled NO_2/NOx Ratios.

Diesel NO_2/NOx Ratios:	**15%**	**20%**	**25%**	**30%**	**50%**
Summer 24-hour O_3 Exposure >90 ppb (%)	-3	-2	0	+2	+5
Winter Peak 1-hr Exposure NO_2 (%)	+1	+6	+12	+18	+41

2. Diesel Oxidation Catalyst Emissions and Disposal

Two potential adverse environmental impacts of the use of diesel oxidation catalysts have been identified. First, as is the case with most processes that incorporate catalytic oxidation, the formation of sulfates increases at higher temperatures. Depending on the exhaust temperature and sulfur content of the fuel, the increase in sulfate particles may offset the reductions in soluble organic fraction emissions. Using low sulfur diesel fuel can minimize this effect. Second, a diesel oxidation catalyst could be considered a "hazardous waste" at the end of its useful life depending on the materials used in the catalytic coating. However, diesel oxidation catalysts are usually recycled for their precious metal content

and thus are not managed as hazardous wastes in practice. Recycling also reduces any potential impact on landfill capacity.

3. Ash Management

Diesel particulate filter technology may generate a new hazardous waste stream. The carbonaceous component of the PM captured by the filter is burned off when the filter regenerates. Any inorganic components left behind after regeneration as ash in the filter must eventually be cleaned from the filter. Based on preliminary data from two samples, the ash may be classified as hazardous waste because of its zinc content.

Ash collected from a diesel engine using a typical lubrication oil and no fuel additives has been analyzed and is primarily composed of oxides of the following elements: calcium, zinc, phosphorus, silicon, sulfur, and iron. Zinc is the element of primary concern because, if present in high enough concentration, it can make a waste a hazardous waste. Title 22, CCR, section 66261.24 establishes two limits for zinc in a waste: 250 milligrams per liter for the Soluble Threshold Limit Concentration and 5,000 milligrams per kilogram for the Total Threshold Limit Concentration. The presence of zinc at or above these levels would cause a sample of ash to be characterized as a hazardous waste.

Under California law, it is the generator's responsibility to determine whether their waste is hazardous or not. Applicable hazardous waste laws are found in the HS&C, division 20; title 22, CCR, division 4.5; and title 40 of the Code of Federal Regulations. Staff recommends owners that install a diesel particulate filter on a vehicle contact both the manufacturer of the DECS and the California Department of Toxic Substances Control (DTSC) for advice on waste management.

ARB staff has consulted with personnel of the DTSC regarding management of the ash from diesel particulate filters. DTSC personnel have advised ARB that it has a list of facilities that accept waste from businesses that qualify as a conditionally exempt small quantity generator. Such a business can dispose of a specific quantify of hazardous waste at certain Household Hazardous Waste events, usually for a small fee. An owner who does not know whether or not he qualifies or who needs specific information regarding the identification and acceptable disposal methods for this waste should contact the California DTSC.[8]

X. ISSUES

Over the course of development of this proposal, staff has met many times with various stakeholders and received written and verbal comments. Although staff has considered each comment, not all issues could be resolved and achieve

[8] Information can be obtained from local duty officers and from the website: http://www.dtsc.ca.gov.

ARB's goals to reduce diesel PM emissions from solid waste collection vehicles. Following is a discussion of major outstanding issues.

A. Cost Recovery by Rate-Regulated Companies

The main issue raised by the industry workgroup to ARB is cost recovery by companies that have their rates regulated by contract with a municipality. These companies, termed "rate-regulated," have long-term contracts and are unable to raise their rates without amending their contracts. As a municipality is often under no obligation to amend the contract until its term is up, the industry workgroup members felt that rate-regulated companies would be at risk of losing profitability because of this proposed regulation.

The industry workgroup therefore recommended ARB require municipalities to bear full responsibility for implementation of the regulation. Collection vehicle owners under contract would not be directly obligated to comply, but rather ARB would enforce against the appropriate municipality if a vehicle was found to be out of compliance. For example, if a collection vehicle working in a specific city on a specific day were found to be out of compliance, that city would be subject to enforcement. By placing the responsibility of implementation on the municipalities, workgroup members felt the financial burden would also be placed upon the municipalities and that rates would be raised to cover the compliance costs.

Staff agrees compliance costs should be reflected in solid waste collection contracts and related fees passed onto households. The industry workgroup proposal, however, creates other issues that will complicate and potentially frustrate implementation. Imposing the burden of implementation on a municipality that has a contract with a solid waste collection company would make the municipality the de facto owner of the vehicle. The municipality, however, does not make purchasing or leasing decisions regarding the vehicles, although it may specify the types of vehicles acceptable through the contract. In addition, the municipality does not employ the maintenance staff, nor schedule or supervise maintenance. Further, placing this responsibility directly on municipalities would require them to hire and train staff to oversee maintenance and ensure compliance, thus duplicating a responsibility of a collection vehicle owner. The costs of this rule would therefore be higher than under the recommended alternative.
Under this proposal, enforcement would be overly cumbersome and create confusion. ARB inspectors would have to determine the municipality for which each truck is working under contract and deliver notices of violation or tickets to the responsible municipality. A truck working for one municipality, however, could be redirected to work for another on a different day because of scheduling needs.

In summary, the industry proposal lacks sufficient enforcement mechanisms, misplaces operational compliance with the control measure, and is neither effective nor efficient at achieving the goals of the Diesel Risk Reduction Plan. This industry proposal would also be more costly than the staff proposal. Staff, therefore, has not proposed placing the sole responsibility for compliance on a municipality that contracts for service. Municipalities do, however, share responsibility for compliance and ARB may enforce against either or both parties when vehicles are found to be out of compliance.

B. Accelerated Implementation

Staff has also met several times with a group representing environmental organizations concerned with air pollution. This group has proposed accelerating the implementation schedule to achieve PM emission reductions sooner than in the staff proposal. Two objectives have been presented to staff: first, to accelerate the oldest vehicles to implement in advance of 2007, and second, to accelerate implementation of the newest vehicles, those with MY 2003-2006 engines.

Staff has already accelerated one group of vehicles in response to this request by moving MY 1988 through 1993 engines into the first implementation group. Staff is continuing to analyze the potential costs and benefits of this option, but our analysis to date does not show a great enough benefit from further implementation acceleration to justify the greater expense of compressing the compliance schedule

Group 2 (MY 1960 – 1987) engines are the most challenging to retrofit with a DECS because they have higher PM emissions and tend to have colder engine exhaust temperatures. Manufacturers of DECSs have also not moved to verify technology for these engines. Staff therefore believes the majority of these engines will have to be repowered. As the new engine standard of 0.01 g/bhp-hr PM begins with the 2007 model year, staff proposes beginning implementation in 2007 to get the maximum PM emission reductions at the most reasonable cost. An earlier start date for implementation would mean that the owner would be required to purchase an engine certified to 0.1 g/bhp-hr and install a DECS to comply. An owner may be able to install a Level 3 DECS, achieving close to 0.01 g/bhp-hr PM emissions, but if Level 3 is not indicated for that engine and duty cycle combination an owner may instead have to use a Level 1 or Level 2 technology, thus achieving lower PM reductions in practice.

Group 3 (MY 2003-2006) engines, while seemingly easy to retrofit, actually suffer from a similar issue. Manufacturers of DECS have thus far had difficulties in verifying passive DPFs for these engines because of the use of exhaust gas recirculation (EGR) to reduce NOx emissions as required. An accelerated implementation schedule could, therefore, result in more of these vehicles using Level1 or Level 2 technology, thus losing emission benefits staff anticipates

under its current schedule. An additional issue is that overlapping compliance schedules with Groups 1 (MY 1988 – 2002) and 2 (MY 1960 – 1987) would increase the year-by-year costs of compliance for owners and make the cost of this rule more burdensome for vehicle owners.

Staff has not, therefore, incorporated the recommendations for accelerating the implementation schedule presented by the environmentalist groups.

XI. SUMMARY AND STAFF RECOMMENDATION

Despite significant success in reducing overall pollution levels, air pollution continues to be an important public health problem. Air monitoring shows over 90 percent of Californians breathe unhealthy levels of one or more air pollutants during some part of the year. ARB has set standards for eight criteria pollutants, such as ozone and PM. In addition to this standard, ARB identified diesel PM as a TAC – a pollutant that even at low levels, may cause serious long-term health effects, such as cancer. These toxics have no known safe levels, and some may accumulate in the body from repeated exposures. ARB must continue its effort to protect the health of Californians, particularly those most sensitive to the effects of air pollution, such as children and the elderly, by reducing pollution from all sources.

Therefore, ARB staff recommends the Board adopt new sections 2020, 2021.1 and 2021.2, title 13, chapter 1, article 4, CCR, in its entirety. The regulation is set forth in the proposed regulation order in Appendix A.

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